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HISTORY

OF THE

MILITARY CANTEEN

BY

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Inspector General U. S. V.
(Major 4th U. S. Infantry)

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This is a publication permitted by the Secretary of War of reports made to the Inspector General of the Army, during the months of September, October, and November, 1900, by Lieut.-Colonel Philip Reade, Inspector General, U. S. V., (Major 4th U. S. Infantry), regarding the Regulation Canteen and other canteens presented for trial with reference to their fitness for use in the military service.

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REPORT UPON ARMY CANTEENS

——BY——

LIEUT. COL. PHILIP READE, I. G., U. S. V.,

(MAJOR 4TH U. S. INFANTRY)

Inspector General, Department of Dakota.

At the beginning of the last century, and for some years after, the soldier's canteen was a wooden, drum-shaped affair, provided with a nozzle. (See cut p. 120.)

To now return to that shape and adopt a hollow cylinder, modeled after a drum for packing figs in, would be an advance backwards.

The history of mankind is the history of the development of weapons and equipment for war by improvements, in which one nation has overcome another and survived.

Within a few months from now our military organization will have been readjusted. The arms and equipments to be necessitated by the increase in numbers of our permanent military establishment should be new and not of the nineteenth century pattern.

By July, 1901, perhaps 60,000 canteens now carried by, or in the possession of, United States Volunteers and Regulars will have been turned in. Some of these canteens will be suspended by the returned volunteers beside the obsolete muzzle-loading firearms of the civil war period, and some may find their way into the museums for the collection and display of archaic military weapons and equipments.

From being an inconsequential article of a soldier's personal equipment the canteen has become, in fact, one of the most important articles, because connected with hygienic considerations; in other words, because it carries water and because the majority of our troops are in localities where good water is of prime consideration to health.

Those who live a comparatively fixed life can hardly weigh aright the importance of a good canteen.

Since the microbe or germ theory has come into the discussion of hygienic conditions, we have learned why it is that bad water is the most dangerous liquid one can drink; that the denizen of places fitted with filtering devices, sterilizing appliances, faucets, hydrants, water valves, pipes, aqueducts, cooling refrigerators, icehouses, etc., can

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guard against micro-organisms and temper the water to suit his palate; the soldier can not so guard himself in the field or on campaign, or on the march.

If the former could only get water by journeying to the town pump, or well having a pole, or piece of timber, moved on a fulcrum or post, used to raise and lower a bucket in the well for laboriously drawing water by hand, he would feel it an annoying hardship. We have relegated the well-sweep, but hung on to the canteen of contemporaneous antiquity.

People who always live in houses and sleep in beds and walk on pavements and ride in street cars, and who get their food from butchers, bakers, grocers, or restaurants, and who always have access to unlimited quantities of good water, don't appreciate—they can't appreciate—water, because it is as free as air.

The circumstances of their existence are too mathematical and secure. They are boarders in this world. Everything is done for them by somebody else. They live at second or third hand. They get their excitement out of the newspapers. If the weather is bad, they are snugly housed. If it is cold, there is a furnace in the cellar. If they are hungry, the shops are near at hand. They might as well be brought up in an incubator.

But where man abides in the fields, after the manner of soldiers in campaign, he learns that his best friends are his arms, his blanket, and his rations; the last named are not any more important than his filled canteen.

Napoleon said: "There are five things from which the soldier must never be separated—his gun, his cartridges, his knapsack, his provisions for at least four days, and his pioneer tool. Let the knapsack be reduced to the smallest size; let him carry in it a shirt, a pair of shoes, a stock, a handkerchief, a tinder box, but let him have it always with him, for, once separated from him, it never returns."

It is submitted that a man will retain things for the preservation of his own life longer than he will retain things for the taking of life. Hence he will hold on to his provisions longer than he will retain implements, such as his gun, cartridges, knapsack, pioneer tool, or even his "stock." In other words, the soldier will include his canteen as one of his best friends. He is never prodigal with his water when inured to war experiences. City dwellers who know that there is always plenty more in the pipes do not appreciate this last fact.

A soldier in barracks, with water closets and baths, requires 25 gallons of water per day. Without water closets and baths he

Methods of wearing canteens.

requires 10 gallons of water per day. In stationary camps, 5 gallons per head for all purposes is required.

A soldier requires on the march, for drinking and cooking, 6 pints a day, increased in a hot climate to 8 pints, and an equal amount for washing the person.

The foregoing are the lowest figures. The hygienic preparations for a campaign, either for the foot or mounted soldier, include a consideration of many rules and precautions that are unavoidably broken or impaired by war, but the three requisites of a camping grounds are water, fuel and forage.

Bad water is the most dangerous liquid one can drink.

The soldier is not dressed or outfitted in obedience to caprices of fashion, but in accordance with the rules of hygiene.

All camping grounds are not near to running streams, or water. Marches must be limited to the human strength and necessities, both as regards travel and rest, rations and water.

During the period immediately following the capitulation of Santiago, July, 1898, the Fifth Army Corps obtained its water from the San Juan river, less than a mile away, by means of canteens. Stalwart, fever-stricken men went thirsty because they shrank from the physical exertion involved in walking down a hill a few hundred yards and then stagger back with a load of filled canteens. Aching heads and flushing faces were relieved by water, but the fluid application was a costly one.

Soldiers, insane from heat, exhaustion and fatigue, reeled into any kind of shelter and would there lie prostrate and gasp, their canteens by their side—empty. Sights like these, and personal deprivation, quicken one's conception and appreciation.

General Viscount Wolseley in his "Soldier's Pocket Book for Field Service," edition 1886, includes in the list of articles to be worn on the person a drinking cup and water bottle. He says: "The best water bottles are those made of ebonite and covered with felt. Those holding a little less than 1 ⅓ pints weigh, when empty, 13¼ ounces; when full, 2 pounds 3¼ ounces. Our regulation water bottle, that is of wood, holds 1 and 1-3 pints; weighs when empty, 1 pound and ½ ounce; when full, 2 pounds 10 ounces. Leather water bottle used in Nile expedition, weighs 2 pounds. Moving across a desert, the first and greatest difficulty is water. You must provide for the carriage of at least 1 gallon per man per diem, with a surplus of spare water of 25 per cent, or whatever your calculation amounts to. In calculating the quantity of water required per man for drinking and cooking, it may be put down as six pints in temperate, and eight

pints in tropical climates. On desert journeys in summer, when hot winds blow, a man requires two gallons a day, but in autumn or winter three pints a day are sufficient."

At Tientsin, China, July 13, 1900, where Col. Emerson H. Liscum, ninth infantry, was killed, Lieutenant Abraham Loeb reports that the regiment lay all day in salt water, mud up to their waists, under a hot sun. "Water gave out," he states, "and the men in their frenzied attempts to quench their burning thirst, would drink that dirty salt water, supplying it in short mouthfuls, as it eddied about their forms."

Regarding the lack of water at Tientsin, the New York Sun's correspondent reports: "One thing this day should teach the American army, one little thing of great importance. I have seen six different breeds of man go into battle today. Every one of them except the American had some contrivance for getting extra water to the field. It has been a fearfully hot day and the men have suffered greatly for water. Our men are notoriously prodigal of the contents of their canteens. They hadn't been on the line two hours before they were running out, and the cry went up for more. But there was no way to get more. The British, French, and Japanese had their donkey carts or mules packed with breakers, but the Americans had nothing and their men had to suffer and stand it as best they could. It is no very great reform to make, but it counts afield."

Major William D. Beach, Inspector General U. S. V., (Captain 3d U. S. Cavalry), Inspector General Dept. of Southern Luzon, P. I., states that "officers and some old soldiers will make their canteens of water last for twenty-four hours if necessary, or else go without; but the average soldier can not be made to do it, and sickness results."

It is an axiom in our service to never start on a march or field exercise without filling all canteens. Company commanders inspect before starting to see that this essential is complied with by all.

The importance of the canteen as an article of the soldier's equipment in the field cannot be overestimated. Its value in garrison is not generally appreciated, because of the ease with which water can be obtained.

A canteen is defined by Webster as being a vessel used by soldiers for carrying liquors, water or other drink.

In the English service the canteen has been made of wood and held three pints. In the United States it is a tin flask.

Col. H. L. Scott, in his Military Dictionary of 1864, defines a can-

teen as a small tin, caoutchouc, or circular wooden vessel, used by soldiers to carry liquor, etc.

Captain Thomas Wilhelm, in his Military Dictionary, 1881, says that a canteen is a tin vessel used by soldiers to carry water on the march, or in the field. It is usually suspended by a strap from the shoulder. In the British service the canteen, he says, is made of wood and is called a water bottle.

Worcester in his dictionary defines the canteen as a small tin or circular wooden vessel which each soldier carries and uses for water.

Chambers' Encyclopedia, edition of 1879, defines canteen as the name given to a vessel used by soldiers to contain whatever beverage may be obtainable on the march or in the field, made sometimes of tin, sometimes of wood. In the British army, the canteen is a wooden vessel holding about three pints, painted blue, and inscribed with the number, or designation of the regiment, battalion and company to which the soldier belongs.

The following are stated to be the specifications for the regulation U. S. Army canteen, viz.:

Made of XXXX tin, circular in shape, $7\frac{3}{4}$ inches in diameter, sides oval and smooth; thickness through, three inches, with a triangular wire loop T soldered on each side to tin loop; mouthpiece with a rim; cork capped with tin; iron wire stem riveted through cork and attached to canteen by a brass chain three inches long, with a ring closed on mouthpiece. Covered first with gray "Petersham," and afterwards with drab duck. The weight of the complete canteen is 12.6 ounces; of the canteen haversack strap, as used by the infantry, 6.3 ounces, and of the cavalry canteen strap, 3 ounces.

The Commandant, Rock Island Arsenal, Illinois, (Major S. E. Blunt, Ord. Dept.) furnishes the following information in regard to the manufacture of canteens at that arsenal: "The present regulation canteen is made up of sheet tin; the two halves of the canteen being formed under presses, soldered together and separate mouthpiece soldered thereto, the triangles for the strap soldered on, and then the canteen covered, first with felt and then with dyed duck of the same material as used for the haversack. After this the cork and chain are added. Inspections are made at each different stage of manufacture and when finally completed before the canteens are packed and transferred to store. The only 'test' made during manufacture is to determine whether the soldering is complete. This is accomplished by placing the nozzle of an air compresser into the mouth of the canteen, plunging the canteen under water, and then

forcing air into it. If there are any leaks they will be discovered by air bubbling in the water. If leaks are found the canteen is resoldered and again tested."

In the matter of canteens we have not kept pace with other nations nor yet with the development and improvements made by inventors and industrial establishments in the United States, and which have been made evident by the open air tests made by me and hereinafter described.

The canteen now and for many years issued by the Ordnance Department, is a poor affair, inconsistent with the improvements made in other articles of the soldier's equipment issued by the same department.

I have found, in the possession of the 1st Cavalry or of the 8th Infantry, canteens made of X tin, of XX tin, and of XXX tin. Owing to this lack of uniformity in material, difference in weight and of durability exists.

Some of the army canteens vary in capacity four or more ounces, the minimum being 42 fluid ounces.

Difference exists, also in the weight, thickness and quality of the felt superimposed upon the flask. These variations are visible to the eye and have been further proven by immersion in water and by flame tests.

The present service canteen is defective because it will not preserve fluid at a palatable temperature, in either very high or very low temperatures. A cause of this defect is that the tin flask is not covered by enough non-conducting material, viz., good, thick, all-wool felt.

First Lieutenant F. L. Knudson, 8th Infantry, a soldier of nearly twelve years' experience in infantry service, says: "The canteen at present issued to the army is very poor. Its shape is such that it is inconvenient to carry, and its covering not sufficiently thick to keep the water cool. The stopper should be fashioned by having its chain secured on the inside of the canteen, because the present method of fastening it is not solid enough and causes the chain to slip off the neck of the canteen and the stoppers are very often lost. The canteen should be made of material that will not rust."

Captain F. H. Sargent, 8th Infantry, says: "Noticed defect in canteen, which should be of such shape as to fit close to the body and should be covered with a good felt, much thicker than the cover now in use, which is of poor material, shoddy and thin."

Captain W. H. Hart, Brigade Quartermaster, N. G. S. Minne-

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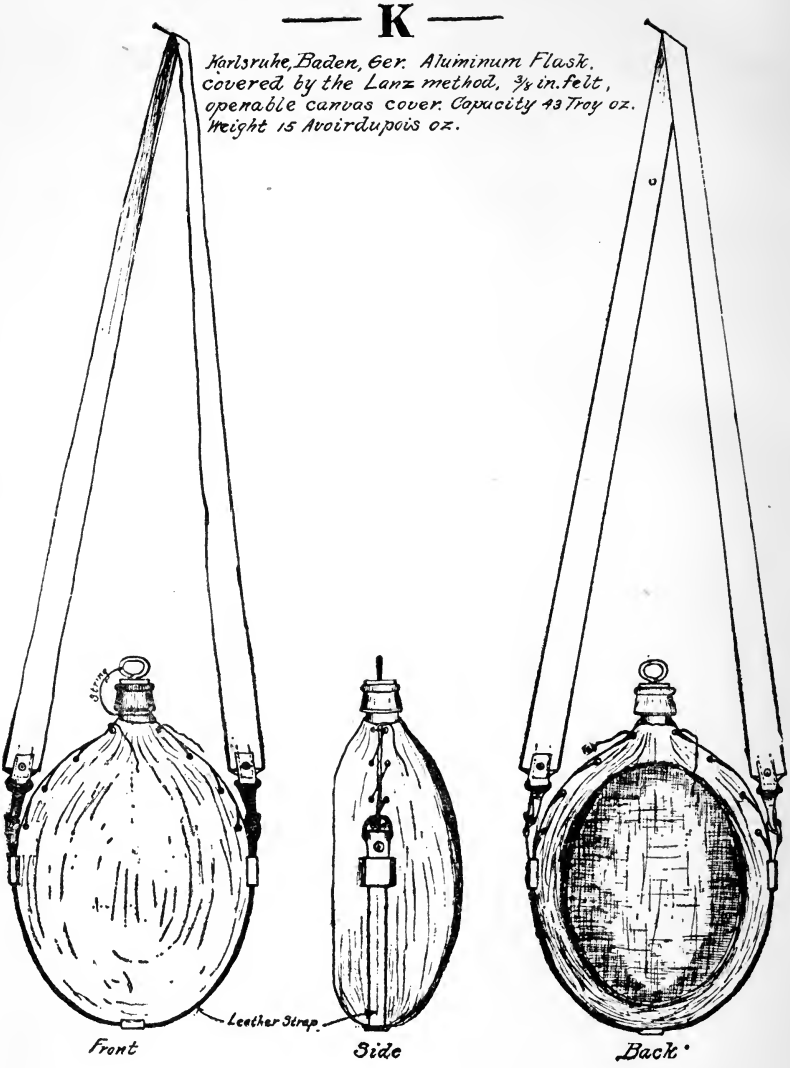
Karlsruhe, Baden, Ger. Aluminum Flask, covered by the Lanz method, 3/8 in. felt, openable canvas cover. Capacity 43 Troy oz. Weight 15 Avoirdupois oz.



Scale: 1/3

sota, writes: "The Government canteen cover is of flimsy material and cannot absorb nearly as much water as a canteen cover of fine piano all wool felt."

Not to change and improve the present army canteen is to run counter to the workings of what clearly is the trend of development in the higher walks of business, science and the profession of arms in other countries.

The service canteen should be a combination of a flask to contain fluids, provided with a cover to keep the contents of the flask at a palatable temperature; that is, a condition with respect to heat or cold in zones, localities or temperatures other than ordinarily prevalent in the temperate zone.

It seems hardly necessary to dwell upon the fact that a canteen flask and its coverings must be separately, as well as unitedly, considered.

The canteen, per se, is a flask to contain forty-eight or more fluid ounces of water. It is in no wise responsible for the failure of its cover to protect its contents adequately from extreme variations of temperature. The flask should be so made, or of such material, as to resist such treatment as a soldier might give it during a campaign, or the march, or in the field.

Respects in Which the Care and Storage of Water in a Canteen Resemble Storage Methods of Transportation of Food Products.

It is not inappropriate to consider water as a food product, and, in hot weather, the canteen as a cold storage house. When the temperature ranges above 90 degrees, it is injurious to water as a food product.

The Subsistence Department, U. S. Army, has to consider temperatures injurious to food products in storage or transportation, and methods of protection from the same.

It is claimed that water is perishable when congealed, or when so hot as to be nauseating. It is also unfit for human consumption when unsanitary from any cause. Protection from excessive heat or cold is as necessary for drinking water as for fruits, vegetables, dairy products, milk, green meats, poultry, game, fish, oysters, clams, malt and hop liquors, wet, canned or bottled groceries, ink, mucilage, proprietary medicines, mineral waters and drugs having water, instead of alcohol, as a base.

Hence, in the construction of a canteen and its components, also in the transportation by the soldier of its perishable contents, primal objects to be attained are:

1. The protection of the contents from frost or excessive cold.
2. The protection of the same from excessive heat.

The temperatures at which drinking waters are liable to damage vary according to their condition when canteened, length of exposure, whether kept continually in motion, etc.

The degrees of cold to which drinking fluids within canteens may be subjected without becoming impaired depends upon the time of exposure, whether allowed to stand, whether partly emptied, and the duration of the exposure, as well as the intensity of the cold.

In the transportation and exposure of the food products, etc., named, concurrence of opinion and method exists as to the modern methods involving the efficacy of cars, etc., specially built, variably ventilated, properly lined and contents carefully packed in straw, hay, oat chaff, moss, sawdust, paper, etc. In the case of the canteen, the lining is properly represented by the cover, or outer jacket.

Just as in the former case, a factor to be observed is the temperature of the produce when put into the car, so the temperature of the fluid or water when the canteen is filled is a factor in determining the merit of the flask covering. If the fluid has been exposed to a low temperature for a considerable time before being canteened, it is in a poor condition to withstand cold, and its original temperature must be taken into account. It is also certain that even a car load of produce, like potatoes, will stand a lower temperature when the car is in motion than when at rest, so it is with a canteen's contents when jolted.

Cars are classed as ordinary refrigerator cars, salamanders and extraordinary refrigerator cars of the better class. Canteens may also be so classed. Some are simply water carriers; others are so protected as to assist in the process of refrigerating their fluid contents.

Car loads of fish, etc., are protected by bins built into the car and thoroughly iced. The modern canteen has its non-conducting cover built on to the *outside* of the flask, and in hot weather the fluid contents of the flask are protected by moistening the absorbent inner cover.

The relation between the outside air temperature and the temperature within the car varies largely, depending on the kind of car, whether an ordinary freight or refrigerator car, whether lined or not, whether standing still or in motion, and also on the weather, whether windy or calm, warm or cold.

In shipping long distances in summer, it is necessary to re-ice the cars.

When the old soldier can, he will, in hot weather, immerse his corked canteen in water in order to resupply the absorbent inner cover with moisture and so retard the subsequent evaporation by keeping the outer cover tightly laced.

It is important to note that in shipping fruits, etc., many of the precautions taken in packing to keep out the cold will also keep in the heat, there being really more danger in some instances from heating, steaming, cooking, etc., by process of decomposition than from cold.

In cold weather the knowing old soldier who wants to keep his canteen full of coffee, tea, etc., hot, puts the fluid into the canteen when it is hot, and he does not wet the felt cover.

Cars containing perishable goods are sometimes, when a south wind is blowing on the prairie, covered with canvas on the south side. They are lined, have padded doors, sides are protected by heavy paper tacked to the walls, also by the addition of an inner board wall a few inches distant from the outer one; produce surrounded by straw, cars warmed by steam from the locomotive when in motion, and by stove when steam is not available. Lined cars are lined with tongued and grooved boards on the sides and ends and bulkheaded. Cars, after being loaded, are carefully inspected as to temperature within; their destination considered, etc.

Cars were not thus equipped, packed and constructed, etc., prior to the construction of our transcontinental railways and cold storage establishments. Twenty-five years ago shippers used ordinary cars.

The development and evolution of the canteen in the U. S. Army has not been such as to justify retaining any longer in service the army canteen now used by our soldiers. The development, improvement and evolution of the service canteen has not kept pace with the progress of the cold storage cars.

In the modern method of storing water in a canteen, the recommendation is made that a modern canteen be used. That is to say, one protected by felt instead of "Petersham," having superimposed an openable canvas cover made of some close woven textile fabric, the pattern of the cover being such as to facilitate the moistening of the felt.

The best method of covering for a canteen known to me is the Lanz method. It does not necessarily quickly produce a low temperature in hot weather, but it keeps the contents of the canteen at a uniformly palatable temperature better than any other practically practicable device suited for the military service and personal transportation by the soldier in the open.

Efforts are being constantly made to reduce the load of the foot soldier to a minimum. He solves the question for himself in the field by discarding non-essentials and so enhances his fighting and marching powers, but retains his canteen whether afoot, mounted or moving by wagon, transport or train. The canteen is not included by him in the list of unnecessary impedimenta.

A soldier must have water, and he must have an appliance to carry water. That canteen is the best canteen which is the most perfect non-conductor of heat and cold.

In a report dated January 20, 1899, from Headquarters 1st Division 2d Army Corps, Camp Mackenzie, Augusta, Ga., recommendation was made that canteens should be covered with felt, or wool, not bare canvas.

I now know that a flannel cover, unprotected, over a canteen, makes evaporation too easy; that a leather covered canteen stops evaporation entirely; that a canvas cover over felt retards evaporation and gives the best results, viz., palatable water of low temperature for troops in the field in the summer season, or any season in our tropical possessions.

It is believed that the function of a canteen is to carry and effectually preserve the temperature of water, either in hot or cold weather.

The present U. S. canteen, as issued by the Ordnance Department, does not satisfactorily preserve or maintain fluid at a palatable temperature in either very high or very low temperatures.

Every question in war should be considered in the aspect of what soldiers can do, and will do, when fatigued. A veteran soldier knows the value of a canteen. The three articles that he will hold on to longest are his rifle, his canteen and his blanket. If he has no ammunition for his rifle he may abandon it, but hang on to his canteen and blanket. He will never part with his canteen. Its value as an article of equipment is attested to by this fact.

The material used to cover the canteen flask, now in use by the U. S. Army, is practically useless as a means for preventing the contents of the canteen from becoming frozen in cold weather.

A method of preventing in hot weather the contents from becoming unpalatable, by reason of high temperature, is to apply a layer of non-heat conducting material to the body of the flask, moistening this material so as to prevent the air from gaining access to the wetted material, thus retarding the process of evaporation.

A method for effecting the desired end, in cold weather, is above

described, except that the layer of non-heat-conducting material applied to the body of the flask should not be moistened.

Old soldiers of the U. S. Army know that a woolen stocking leg pulled over a canteen helps to keep the contents cool, and they also know that, in tropical regions, the evaporation is retarded and the canteen contents thus kept palatable, especially if a dry cotton stocking leg is pulled over the wet woolen one.

The veteran soldier, plainsman, scout or hunter, will, during hot weather, "dip" his canteen whenever opportunity offers.

The body of the metallic flask used as a canteen should be thoroughly covered with all wool felt, or other non-conducting absorbent fabric, material or substance, or by a combination of such. The better the felt, the better its absorbent properties, and the better are the results attained in any open air temperature to which the canteen is exposed.

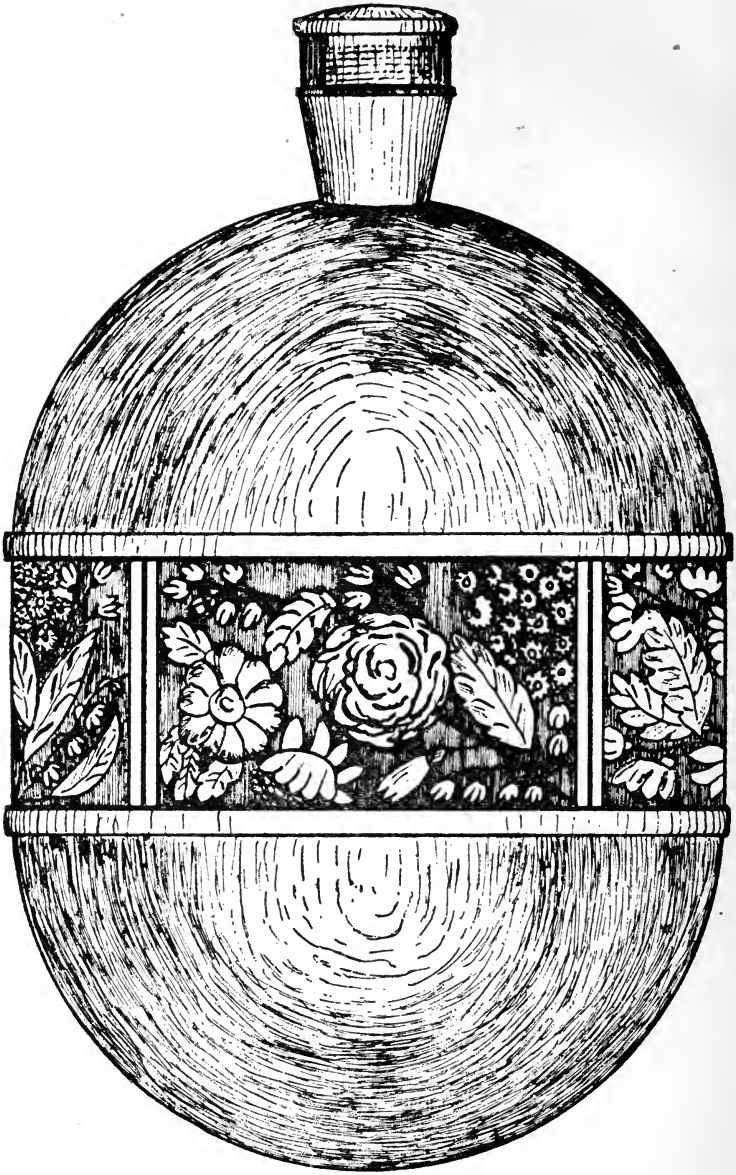
There is a kind of felt, so-called, used for lining horse boots for wear, for padding saddles—"hair felt" it is called. Hair felt is sometimes wool mixed with hair of goat, ox, hare, rabbit, musquash and cotton or jute. Saddler's felt may be some wool mixed with any serrated edged, jagged or notched hair, the barbs of which point to the tip of the hair.

The piano felt used on one pattern of the Lanz canteen heretofore mentioned is unwoven, clear, all-wool, and weighs about three (3) pounds to the square yard. It is of 1-8, 2-8, 3-8, 4-8, etc., thickness, but the thickness alone does not indicate weight. It can be made of any reasonable thickness. It is said by piano manufacturers to be made in different weights, from one (1) to five (5) pounds per square yard.

Another type of the Lanz canteen is protected by a wool sponge woven felt fabric; a new departure, made in Amsterdam, N. Y. Its efficacy as a canteen flask cover has not yet been fully determined.

Over the non-conducting material on the body of the flask should be superimposed an openable cover of some close woven textile fabric. An advantage of the partly openable duck, or canvas, cover, is that it facilitates moistening of the felt. When the cover is laced up over the moistened felt, evaporation is retarded and the contents of the canteen kept at a palatable temperature for a much longer period of time than if the present service canteen is used.

It is fully recognized that the determination of the best canteen should rest upon their use in the field, and not by experimental tests in the hands of officers not serving with troops. Durability, corro-



Pattern of Metallic Flask, screw top, submitted by the Lanz Canteen Co., Chicago, Ill. Ornamental band around middle.

sion, etc., of metal flasks, can be so determined. Facts of this kind find in the field their best proving ground.

Preparations for war include tests of appliances for war. The testing mania is overdone when a weary round of experimenting is done to determine questions that have already been determined by field use.

Somnolent experimentation is out of place, for example, with the present canteen, antique a quarter of a century ago. Line officers who have been stationed in New Mexico, southern California and Arizona, to say nothing of Cuba and Porto Rico, know that a metal flask, used as a canteen, should be covered with a non-conducting substance; know that thick wool felt should be substituted for the "Petersham," or thin stuff, now superimposed upon the flask; know that this felt should be kept moist in a hot climate, in order to keep the contents of the flask palatable; know that this woolen cover should have an outer cover that will allow, and retard, evaporation. No "tests" by any board are required to demonstrate these facts.

Description of the Arizona Canteen.

The Arizona canteen, cavalry size, weighs, dry, 40 oz.; wet, 82 oz.; holds 86 oz. It is covered with common saddler's felt, $\frac{3}{4}$-inch thick, over which there is a canvas cover, whose edges through a portion of its circumference are partly laced, instead of being stitched—hence openable. The seams along the edges of the flask are permanently stitched from the nozzle in each direction for a few inches.

Originally—that is, in May, 1898—the outer covering was composed of several thicknesses of blue flannel. The object of having an openable canvas cover, laced for a portion of its circumference, was for the purpose of admitting moisture to the inside felt and to secure the cooling effect due to retarded evaporation.

The cover is made in four sections, two around the edge or circumference, the remaining two being applied to each side, or face, of the flask, all joined by being stitched, except where lacing instead of stitching, is used on the circumference of the flask.

A similar canteen, having a rigid central support, was carried by me along the Gila, Colorado and Rio Grande rivers twenty-five years ago. This particular canteen also accompanied me, when mounted, in the province of Santiago de Cuba, June-August, 1898, and, later, in the province of Havana. It was my custom to wet it at sunset, and suspend the canteen for the night. It kept water at a lower temperature throughout the following day than any other portable appliance known to me.

Complaint is made from the Philippines that the canteens used there always flatten after much usage, the flattening beginning on the side which rests against the saddle blanket.

Before the days of railroads in New Mexico, southern Arizona and California, the canteens carried by us, in summer time, were large enough to hold about six pints of water. Existence depended, sometimes, upon the contents of a big canteen. They were so large that flattening was prevented, at the expense of weight, by an inside central rigid support, made of the same metal as the flask, which support was soldered to one-half of the canteen before the halves which constituted the faces were put together.

The Parker Canteen.

The Parker canteen, like the Pasteur filter, has a tube. The liability of the filtering tube to fracture by jolting incident to carriage and use, prompts an objection to its adoption for military use in the field. This objection is based on the fragile material from which the tube is made. The filter tube displaces about its own weight of water from the filled canteen, thus limiting the supply of fluid which the canteen would otherwise hold. As water will not normally arise above its own level, it follows that when the canteen is only half full, the filter tube is only half full, etc.

These canteens are made of tin, into the composition of which iron enters. Complaint was made by those of the Seventh U. S. Cavalry who drank in the province of Havana, the Vento spring water, or other water of that class, that contact of the fluid with the canteen was followed by chemical action, oxidation, and that the water in the canteen became the color of iron rust.

The deposit of oxide in the filter of the Parker canteen closed the pores and it soon ceased to be a filter. The closed end of the tube showed then a deep iron rust color and the water became undrinkable.

The Parker canteen was reported on from Headquarters Department of Havana, April 24, 1899, after consultation with officers of the Second Squadron, Seventh U. S. Cavalry. I have not since been brought in contact with troops provided with any of the Parker canteens.

In my report to the Inspector General, through proper channels, dated April 27, 1899, inspection Seventh U. S. Cavalry, I outlined the following undeniable principles, viz.:

1. Filtration has for its object the removal of suspended matter.

2. Organic matters adhere to the surface presented to the fluid within the flask.

3. Water passing slowly through it makes deposits in the interstices.

The Parker canteen has a filter tube inside the flask; it is attached to an ordinary cork capped with a cap of hard rubber material having a removable cap, and a drink is obtained by suction, the fluid percolating through the filter, which appears to be of infusorial earth or stone.

The continuance of the action of the Parker filter, or any other filter is limited.

Soldiers in the field will not find it practicable to clean the Pastuer, Parker, Berkfield or any other kind of filter made of infusorial earth.

If the Parker filter is not cleaned, it clogs, and soon ceases to be a filter.

For these reasons, apart from its friable nature, it is the opinion of Captain Luther R. Hare, Seventh U. S. Cavalry, and of the other officers of the Seventh U. S. Cavalry, formerly on duty in Cuba, that the Parker filter does not possess sufficient merit to warrant a further trial by U. S. troops.

The tube alone weighs eight (8) ounces. The flask weighs sixteen (16) ounces, holds about 56 ounces, avoirdupois, of water, less the amount displaced by the filter. The latter is $5\frac{1}{2}$ inches long; diameter, 1 inch.

Experience is a safe guide. Filters were numerous at the beginning of the civil war, and the volunteers bought filters numerously at the begining of the Spanish-American war. They were serviceable for a while, but campaign exigencies relegated them to the list of non-essentials, where plainsmen and old hunters had already placed them.

The objections to the Parker filter for use in a military canteen, aside from its weight, clumsiness, etc., are that it is brittle and liable to fracture, particularly when moist. A crack becomes a structural imperfection. It cracks easily. Unless cleaned and sterilized frequently, the pores of the filter become filled with organic matter, which, decomposing, becomes offensive and a good culture bed for micro-organism.

The objection that, after some use, it will become a breeding ground for bacilli and germs, is a vital one.

The Parker filter is not capable of efficiently removing bacteria and other micro-organisms from water. Frequent cleaning by hot wet, or hot dry, process, is necessary. These processes are not always practicable by soldiers. Cleaning by brushing will wear away

the bougie or tube. Such, in any case, will not cleanse below the portion touched.

The Aluminum Canteen, 60 oz., German Cover.—The Karlsruhe German Aluminum Canteen.

Through the courtesy of Messrs. George and William Lanz, 183 Lake street, Chicago, Ill., I have been furnished with two aluminum canteens, one having a capacity of sixty (60) ounces; the other forty-three (43) fluid ounces, both flasks fabricated in Karlsruhe, Baden, Germany. The large flask has a German-made felt cover—no canvas—weight, including carrying strap, fourteen (14) ounces. The medium flask has a Lanz cover, and inner cover of the kind patented by Mr. Lanz, August 14, 1900; weight, fifteen (15) ounces. Cuts of the two are shown herewith. (pp. 115, 10.)

These canteens were tested by me in the open air, in conjunction with others. In the first tests made, each flask was filled to its full capacity. In the subsequent tests, the amount of water in each was the same, this in order to equalize conditions as much as possible.

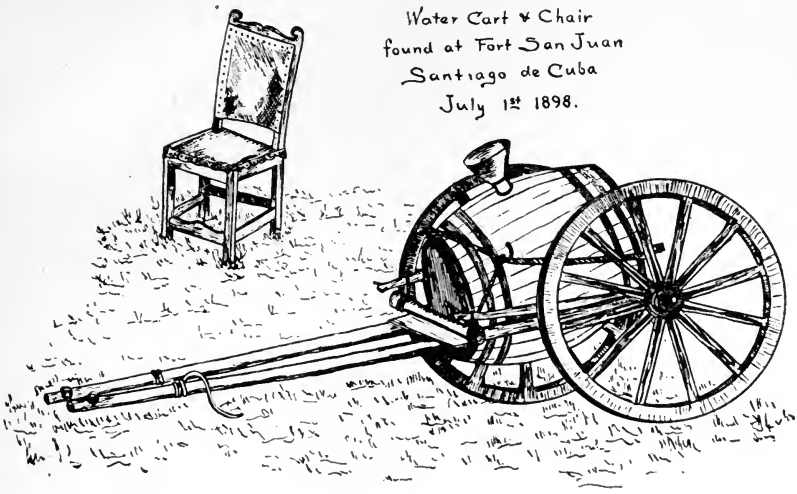
The Dubuque Stamping and Enamel Canteen, with the Parker Filter.

It is understood that this is a naked metal flask, coated inside and outside with some kind of agate, vitrified, glazed, incrysted, porcelained, lava, granite or annealed ware. If it chips like the enameled agate ware used in furnishing officers' mess chests, its use will be dangerous if the chips are swallowed. In composition it is understood to resemble the kind of ware commonly used in cooking utensils. This type, viz.: uncovered metal, is merely a thing to carry fluid in without pretending to keep the fluid at a palatable temperature.

Whatever canteen is adopted, it is essential that the flask be covered with a non-conducting fabric or substance.

The lower part of the neck, or nozzle, or mouth-piece, of the Dubuque Enamel canteen forms a right angle with the side-band of the flask, and so cuts away the filter part of the Parker tube, exposing the center metal rod. This cutting away causes the friable matter of which the filter is composed to break away from the rod. The jolting incident to transportation would probably cause it to disintegrate, if used in the Dubuque Enamal canteen, owing to the mechanical construction of the neck of the flask.

A dealer in white enamel ware, manufactured in Sweden, states that that process of enameling is like that pursued in this country in painting bicycle frames and then burning on the paint.



Water Cart & Chair
found at Fort San Juan
Santiago de Cuba
July 1st 1898.

Canteen worn by Privates of Volunteer Infantry. 1864.

Canteen worn by Infantry. U.S. Army, 1876.

He has for sale utensils made of the ware, iron base, white enamel and says that they will stand the test of fire without fusing; in fact that coffee could be boiled in any of the utensils; but admits that the ware will chip, little fragments break off, thus exposing the iron base rust then sets in, undermining the rest of the glaze, enamel, vitreous coating or material used to give the metal a porcelain or agate coating. Makers of bath tubs have had the same trouble in making the enamel stick to the metal.

The material which enters into the canteen made by the Dubuque Stamping and Enamel Company may be of some such combination ware as the Swedish lacquered or glazed ware. If it is, a proposition from a would-be contractor to furnish such canteens for military use would incite the condemnatory sense and sentiment of practical soldiers.

The Dubuque Enamel canteen is not so good as the present type of regulation canteen. Tests have proved its worthlessness, except to carry water in. Its shape is about identical with the wood canteen, or water bottle, contemporaneous with our second war with England. The modern canteen is not of circular, but of oval, gourd, oblong, bottle, or flask shape.

The Newark, New Jersey, Aluminum Canteen Flask.

The New Jersey Aluminum Company, Newark, N. J., submitted to me for test three samples of their aluminum canteen flask. (See "M," "N" and "O" Test Tables, pp. 64). All are of circular fig-drum, or cheese-box shape. The mouth-piece appears to be soldered on; its diameter is considerably less than that of the orifice in the side piece of the flask, and it is a separate piece of aluminum; the side-rings are inserted in ears riveted to the flask. Each flask apparently consists of eight pieces, the rivets not being counted, including the wire loops. The finish is such that no seams are visible. The firm claims that the flasks are made without the use of solder. They are not provided with covers or stoppers. One face is flat, perhaps slightly concave, the other face being convex.

The aluminum canteen flask, made by the Newark, N. J., Aluminum Company, and covered by the Lanz method, $\frac{3}{8}$-inch felt, and openable canvas cover (termed in test tables p. 64, canteen "F"), underwent thirty-four tests by me, on as many different days. It has on each side a flat piece of the same metal, aluminum, riveted to the flask. This flat piece is doubled and bent so as to make a loop in which there turns a bent piece of looped wire, which serves to attach the hook, or snap, of the canteen strap to. Three rivets are used in

each flat piece; no soldering visible; length of rivets unknown. No leakage occurred during any of the tests at the points where rivets were used.

Eyelets of the outer canvas cover, Lanz method, are reinforced on the inside by a bit of canvas, folded double. The all-wool felt used as the inner jacket consists of two pieces, each cut with a beveled edge in order to give the jacket a snug fit where joined. These pieces are neatly secured together by stitching of copper or aluminum wire.

This firm writes as follows: We are in receipt of your valued favor of the 14th instant, together with the enclosure of the various tests of canteens. We observe that two of ours proved leaky, while the others bursted. We also take note of the fact that other canteens fared no better. These tests are indeed valuable to every manufacturer of canteens, and you may rest assured that if given another opportunity we are still in the race. We think that we would know how to make a canteen, and confess that we think your tests rather severe. We especially observe your remark of a canteen of the oval type, concaved on the side which comes next to the body, and convex on the outer side, to hold 48 fluid ounces. To prove to you that we can make such canteens (in fact, we have made flasks of just that particular type), we are forwarding to you one under separate cover, which, by the way, you need not return if you care to keep it. There is but one hitch in this particular canteen, that is to fasten the rings by which the canteen is carried. Just as soon as we attempt to rivet there it makes the weakest point in the canteen. We may, however, find some other way to overcome this. We should very much like to send you one of the requisite size, but as there is considerable expense connected therewith to produce it, we hesitate until we hear further from you. You can, of course, readily understand that each and every manufacturer competing in this matter is desirous of obtaining an order with some profit to himself. It is, therefore, we speak as we do; we prefer for the present not to make the larger size, which we know would be perfect, especially if made of one piece as you suggest. Now, if you think it would pay us to go into it and make the dies and tools for producing a canteen of that kind, we are willing to take the chances as regards the test, but if there are no prospects, we would very much thank you to tell us so.

Thanking you kindly for having given us the opportunity to look over the tests, we remain, etc.

The Reymond & Gottlob Aluminum Canteen.

Some of the canteens to which the consideration of the military men are invited are picnic affairs, suited, perhaps, for a tourist, or a

bicyclist on a summer outing, but not adapted in construction, shape, capacity, durability or rigidity for military purposes.

Of this class is the aluminum canteen, retail price, $1.50, sold by Messrs. Reymond & Gottlob, 831 Broadway, N. Y. Its weight, including cover, is 8 oz. It is of circular shape, fig-drum, cheese-box appearance, covered with a single thickness of what may be felt. Dimensions, 6 in. diameter, 2½ in. deep. It is not seamless; flask not of one piece. It is said to be spun. No solder is said to be used. The felt covering buttons upon the outer, or convex, base of the flask by flat-headed glove-buttoning fastenings, and the sling, ⅝ in. wide, is of strap leather. It is doubtful whether the button fastening method would be durable.

Being filled to its capacity (29 fluid ounces) with water having a temperature of 94 degrees F., it was exposed with others in the open air at a temperature varying from 4 degrees F. to 10 degrees F. At the end of four hours the contents dropped to 32 degrees. After an exposure of six hours, the contents were frozen, and it leaked in all succeeding tests.

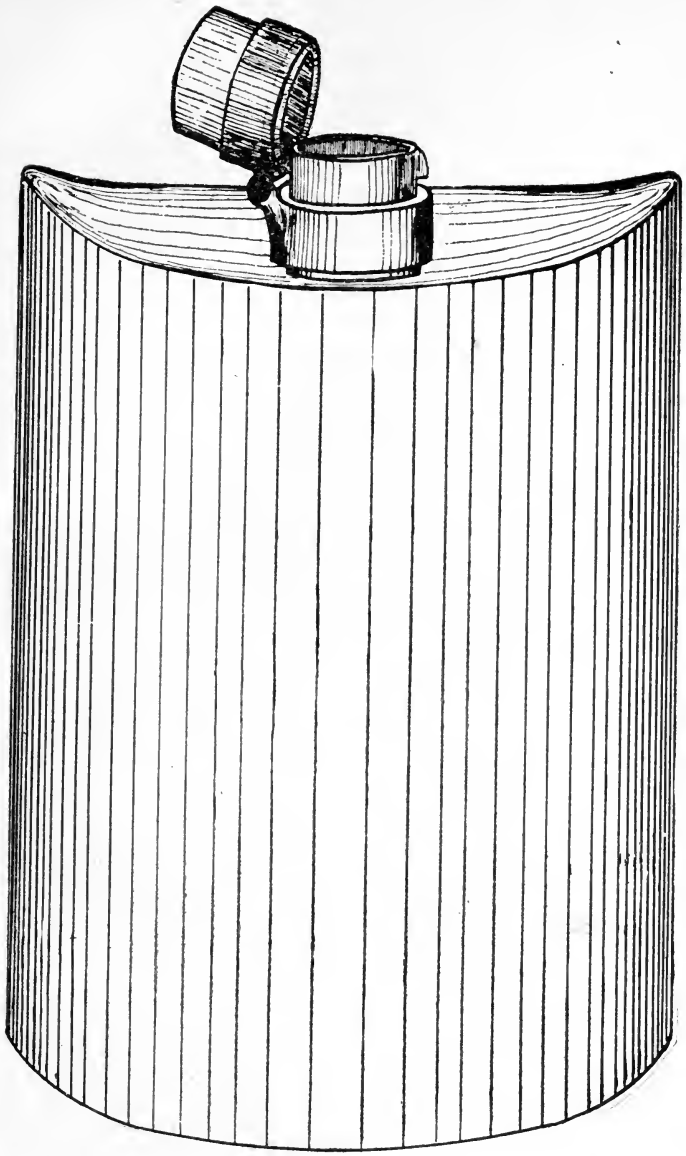
Its resisting, or non-conducting, properties are about the same as the Government regulation service canteen, ordnance pattern, which is protected by "Petersham" (or shoddy felt), and canvas cover. Perhaps it should be rated a little above the Karlsruhe, Baden, Germany, aluminum canteen when covered by the single felt German method.

Messrs. Reymond & Gottlob are importers of aluminum fancy goods and novelties, branch at 109 Fulton street, factory, 115-121 East Thirteenth street, New York. The firm writes as follows: "We can make the desired canteen, provided it is ordered in fair-sized quantities, and if you could submit a sample of one you think the most useful, we would be thankful to you. We have no connection with any European house, and would not know what is desired for your purpose.

We truly believe that our canteen is superior to any one in the market and has no equal. As to durability, it outlasts any one, besides being as pure as gold, and will not rust or change any, and think it is the most useful thing for the army.

We are very anxious to have you make a trial, and kindly ask you to report to us the results. Further, wish to say that we have sold these to a good many officers of the U. S. Army, and every one has given our canteens the highest praise.

We have tried over and again to get the Government interested in the same, but there seems to be a hitch somewhere which we cannot explain.



Prince of Wales Metallic Flask, shaped to fit the person, with Bayonet top which can not become detached. Capacity 33 fluid ounces. Submitted by the Lanz Canteen Co., Chicago Ill.

We guarantee every one of ours to be water-tight, and eve soldering can be done on them."

THE PRESTON FIELD RATION MESS KIT.

Gradually the armies of the world are adopting aluminum fc mess kits, and the Ordnance Department of the U. S. Army has fc a number of years been testing the qualities of aluminum for th purpose. Owing to the Cuban and Philippine wars, these tests hav been somewhat delayed, but during the last year the department ha issued to the service, for trial, one thousand sets of the Preston Mes Kit.

This kit was patented March 3, 1896, by Lieutenant Guy H Preston, U. S. A., and is made by the Scovill Manufacturing Con pany, Waterbury, Conn. The retail price of same, complete, is $4.5(

A glance at the illustrations will demonstrate the improv ment in compactness and convenience over any kit now in use. Bein made wherever possible, of aluminum, it has the additional advantag of increased lightness, and strength as well. Its weight, with cove is 2 lbs. 5 oz. The only metals used in any way are aluminum, ti and iron, so that no injurious salts can be formed by corrosion.

Following is a description of articles of which the kit is com posed:

The Canteen Proper.—This has a capacity of little over thre pints. It is made of heavily coated tin, soldered at its joints. Tin i used rather than aluminum, because as yet no satisfactory solder ha been found for aluminum, and the canteen could not well be mad without joints. The cork has a cap of aluminum to keep the corne from crumbling when inside, and cannot be lost because of a chai and bar which hang on the inside of the canteen.

Frying Pan.—This is made of aluminum with a heavily tinne steel handle, which, when packed, swings back on a hinge and lie flat on the bottom of the pan. A very ingenious and durable devic with a sliding pin, which cannot be lost, is used for holding the handl in position when in use. The pan is about 1 inch in depth and fit over the side of the canteen when in the canvas cover. This fryin pan has a cover, which is its counterpart in size and shape, and fit over the other side of the canteen when inside of the canvas cove This may be used as another cooking pan or serving dish. It has n handle, but may be locked tightly over the top of the frying pan thus making a case for carrying rations or may be slipped loosely ove the frying pan, thus making a fine baker.

Cup or Sauce Pan.—This is made of aluminum with a heavil

tinned steel handle, which, when packed, closes within the cup. When in use, a small gravity catch keeps the handle in its proper position. The cup is strongly reinforced where the handle is riveted on, so that the weight of its contents will not work it loose. This cup, when packed, slips over the bottom of the canteen, which it fits snugly.

Canvas Cover.—This is very strongly made of the best brown canvas. A strong canvas strap with an adjoining buckle is securely sewed about the bottom end of the cover. This cover may also be furnished with D rings, when desired, to take the regular cavalry carrying strap issued by the Quartermaster's Department. The top of the cover is laced tight about the canteen, leaving but the neck exposed. Inside is a double lining of gray felt, which is secured to canvas. This is to keep the water cool. The aluminum pans are also a help in this respect, as aluminum is a bad conductor of heat. A pocket is sewed to the inside of the canvas to hold the knife, fork and spoon, which are made of steel, very heavily tinned and silver plated. Being made of steel they are strong and can easily be kept sharp, and being tinned they do not become rusty.

Captain W. C. Brown, First U. S. Cavalry, is quoted as stating that: "The Preston Mess Outfit is very convenient and suitable for officers' use, but the aluminum sheet used for the frying pan and plate, are rather too thin to withstand the rough usage which they will get in the hands of enlisted men."

The Cowles Canteen.

Name of inventor, John T. Cowles, 224 East Washington street, Chicago, Ill., alleged to have assigned same to Mr. George Lanz, 183 Lake street, Chicago, a manufacturer of leather goods, and who has furnished ordnance leather equipments to the Ordnance Department U. S. Army, also to English forces now in South Africa.

This invention relates especially to army contracts for the use of foot and mounted soldiers, but may be adapted as well for large water receptacles, such, for example, as may be used for carrying a temporary supply of water for horses in cavalry and artillery service.

The object of the invention is to provide means for more effectually preserving the temperature of water either in hot or cold weather. For individual use, the flask of the canteen is of the usual double convex type. It is a canteen in combination, basing its merits, in part, upon the physical principle of convection. A covering of fibrous material is applied to the flask and impregnated with a non-heat-conducting material. There is a filling of corrugated fibrous paper interposed between the fibrous covering and spaced apart from an

outer rigid shell, which encloses the whole. The walls of the shell have rigid supports. The shell has a textile cover.

The canteen is provided with the usual nozzle and chained stopper. The materials used to impregnate the felt, or other fibrous material used as a cover to the flask, are said to be sulphate of aluminum, common salts, and sulphate of ammonia, or the three mixed. It is stated that the inventor does not desire to be limited to these particular substances, as there are many materials which may be applied to a fibrous carrying substance with greater or less efficiency, the process being to conveniently impregnate the fibrous material by saturating it with a solution of the substance and then drying it out.

The covered flask is encased in a shell of sheet metal, spaced apart from the fibrous cover, so as to leave an air chamber. To the case there is applied the usual fibrous jacket, and this, in turn, is enclosed by means of a canvas cover which is openable through a portion of its circumference, the seam along the edge of the flask being permanently stitched from the nozzle in each direction for a short distance and through the remainder of the circumference of the flask being closed by lacing, so that the canvas cover may be opened for the purpose of admitting moisture to the fibrous material, whereby the cooling effect, due to evaporation, is secured.

See "Lanz Canteen" for this form of laced canvas cover.

The shell has a cross-rib support applied to its inner face central as to the sides of the flask and bearing against the fibrous cover, so that the shell will not be easily indented. The corrugated paper used as filling is impregnated with a non-heat-conducting material. One form of the shell of the Cowles canteen is corrugated, the corrugations being arranged meridianally as to the shell and being of maximum depth across its equator and disappearing at its polar portions.

The inventor claims that by the use of the outer covering of felt protected by a close woven fabric, such as canvas, the benefit is secured of the long continued effect due to slow evaporation, the felt having been saturated when the canteen is full.

The canteens heretofore made have proved inadequate as to means for keeping the water sufficiently cool to be palatable in hot climates. For this reason the expedient named is supplemented in the canteen forming the subject of this mention, by the metallic casing enclosing the flask in such manner as to form with the walls thereof an air-space. The advantage gained by this construction is decidedly augmented by the layer of fibrous material applied directly to the flask, and by but partially filling the air-space between it and the casing, this fibrous material being itself a good non-conductor of heat, but being rendered far more efficient in this regard by being

impregnated with the substances named, which possess very low conductivity.

By supplementing these features with the corrugated paper placed with the air-space named, a further marked advantage is secured, not only because of the efficacy of the paper, especially when impregnated with the materials named above as non-conductors, but because of the sub-division of the air-space into numerous cells, thereby preventing the circulation of air and the consequent transmission of heat by convection.

The principle of the invention is not limited to this, or any other canteen form, but is equally applicable to a flask or tank of any shape.

The Lanz Canteen.

Name of inventor, William Lanz, and manufacturer, Mr. George Lanz, 183 Lake street, Chicago, Ill.

The canteen is one of the few articles of equipment that the properly trained soldier will never part with. Every question in war should be considered in the aspect of what men can do, and will do, when fatigued. Mr. George Lanz is a reputable wholesale manufacturer and contractor for leather goods. He has made a large number of saddle bags, pistol holsters, etc., for the Ordnance Department, U. S. Army, and for the British service.

This invention relates to army canteens and the like, and its object is to provide such a cover for the sheet metal flask, of which such articles are usually composed, that it will more effectually prevent changes of temperature of the contents than has heretofore been accomplished. The usual reliance for acomplishing this object has been a jacket of a substance called felt, or of a mixture of cotton or jute mixed with wool, called felt, covered with canvas, which jacket is so intended that by the process of evaporation the contents of the flask will remain cool.

This means for preventing the contents of the flask from becoming warm has been inadequate because the outer covering of the canteen has usually been of finely woven canvas, or like fabric, which is very nearly water-proof, and hence, although water may have been poured upon the canteen, or the latter may have been dipped into water, the moisture would not penetrate the canvas covering, and hence the inner lining of cotton and jute mixed with wool felt would remain dry.

The form of construction now in use by the U. S. Army also is, of course, practically valueless as a means of preventing the contents of the canteen from becoming frozen in cold weather.

One form of the Lanz invention consists in covering the flask with a material, or a layer of material, having a low heat-conducting character, and placing over the layer an envelope of water-proof material, so that the inner layer will never become wet; upon this envelope is superimposed the usual jacket, or jackets, of fibrous material, such as felt, and this in turn is covered with canvas or similar textile fabric, closely woven, so that it is almost impervious to water.

This outer cover is openable, its seam being in part formed by lacing, so that it may be readily opened for renewal or for the purpose of permitting moisture to freely enter the felt jacket when the canteen is immersed in water.

The invention consists further in making the canteen with one of its sides flattened or slightly concave.

Drawings illustrating this invention, side elevation, edge view and transverse section, are in the possession of the inventor at No. 183 Lake street, Chicago, Ill. (See page 31.)

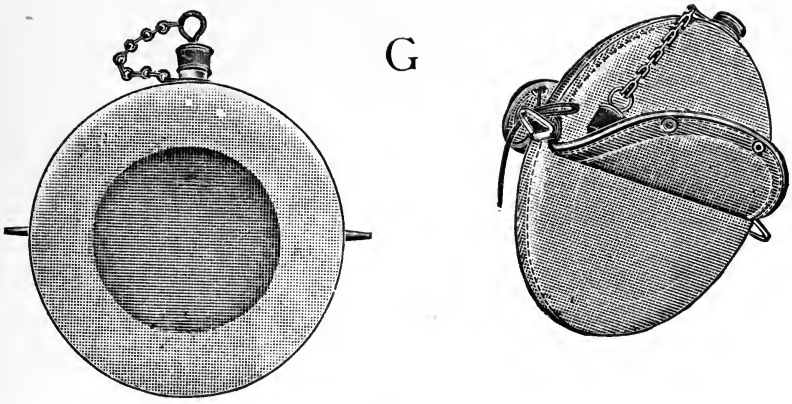
The flask is the usual rounded double convex form, except that one of its sides is made slightly concave, so that it may rest more easily upon the hip of the user when slung from the shoulder. The flask is provided with the usual nozzle closed by a stopper provided with a chain and ring.

A layer of non-heat-conducting material is applied to the body of the flask, preferably granular cork is used for this purpose, and it may be secured to the canteen by first coating the latter with a suitable cement and then sprinkling the cork upon it while the cement is moist; or the cork may first be molded into a shell adapted to fit snugly against the side of the flask. Other forms of the Lanz canteen omit this layer.

This layer of material is enclosed in an envelope of water-proof material. For this purpose oilcloth is preferably used, though any material which will prevent water from gaining access to the cork will serve.

Upon the envelope is superimposed a layer, or layers, of fibrous material, preferably felt, and this, in turn, is encased in felt, wool, canvas or other fabric. This cover is made in two sections, one applied to each side of the flask, the two being joined by a seam which may be permanently and closely stitched from the nozzle part way round the canteen; but through a considerable portion of this seam, preferably exceeding one-half of the circumference of the canteen, lacing is used.

In use, the lacing is, or may be, opened after the flask is filled,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and the canteen, if the water or weather be warm, is then immersed in water so that the felt jacket may become thoroughly saturated. The lacing is now drawn tightly so as to prevent the air from gaining access to the felt, and thereby the process of evaporation is greatly retarded, so that under ordinary circumstances the felt will continue moist for a number of hours.

The layer of cork, or other material, prevents the heat from passing through the walls of the flask when the temperature of the felt jacket is raised above that of the contents of the canteen, so that the water remains cool and palatable for many hours after the flask is filled.

The office of the water-proof envelope is to prevent the layer of non-heat-conducting material from becoming weighted, and hence, in time, foul, and also to prevent the metal of which the flask is formed from corroding.

In cold weather the felt is, of course, not moistened, and, being, when dry, an effective non-conductor of heat, it, with the inner layer of cork, or similar material, will prevent the liquid within the canteen from parting with its heat for a considerable period, so that the danger of freezing is greatly lessened.

While the construction heretofore mentioned may be preferable to any other, the water-proof layer of non-heat-conducting material may be omitted and the jacket of fibrous material be applied directly to the body of the flask, enclosing it within the canvas cover which is openable for the purpose of admitting moisture to the felt, and may then be closed by lacing, so as to greatly retard the process of evaporation. Many of our old soldiers have learned that a woolen stocking leg pulled over a canteen helps to keep the contents cool.

An English patent of 1884 describes a canteen with a felt covering and a leather cover laced over it. An Italian patent of 1871 refers to a felt and flannel laced cover for a canteen. It is claimed that neither of these can accomplish what is claimed for the canteens made by Mr. George Lanz, 183 Lake street, Chicago, Ill., viz.: Retard the evaporation. Experimental tests have been made by Mr. Lanz demonstrating varying and relative results, using a canteen with a leather cover, with a flannel cover, with a canvas cover.

The merits of the Lanz made canteen are that it will keep cool water at a low temperature, reduce high temperatured water to a drinkable temperature, or warm liquid at a high temperature, longer than any other canteen now in use by any military power.

These results are accomplished by enveloping or casing the can-

teen with a non-conducting substance, such as wool, felt, cork or granulated cork, sometimes in conjunction with a certain cement.

Another device of his manufacture is to encase the protected canteen by an outer shell of metal, there being an air-space between the shell and the enveloped canteen. The shell is held away from the canteen by two beveled cork buffers. These buffer heels also protect the canteen. The whole is then covered.

It is designed that each soldier shall carry one, suspended by a strap from the shoulder, to carry cool water, hot coffee, or whatever beverage may be obtainable on the march or in the field.

It is claimed that the drinkable properties of the liquid continue for a longer period than by any other device patented, or used, by any army.

The Lanz canteen is not a tin flask enveloped with a thin mixture of cotton, wool or jute, then canvas covered.

The patentee makes the canteen of aluminum, and also of various other metals, or combinations of metals; likewise of wood, paper pulp, caoutchouc, etc.

In shape, the circular form is generally preserved, but one face is convex, the other being concave. When slung, the concave face is next to the body of the wearer. A filter may be fastened to the nozzle or mouth, if desired. The capacity may be from three pints upward, same as model, Ordnance pattern, U. S. Army. The cavalry model canteen is of larger capacity than the one designated for the equipment and transportation of foot soldiers.

The weight of the Lanz canteen is about six (6) ounces in excess of the U. S. canteen of the same capacity, forty-six (46) fluid ounces of water, being twenty (20) ounces of avoirdupois.

The following tests are reported by him, five (5) canteens being used:

First test. No. 1, U. S. canteen, as issued by Ordnance Department. No. 2, Lanz canteen. No. 3, another Lanz canteen. Temperature of hydrant water with which each canteen was filled, fifty-five (55) Fahrenheit. Exposure at rest, 115. Time of exposure, 6 hours. Results: No. 1, U. S. canteen, 94. No. 2, Lanz canteen, 76. No. 3, Lanz canteen, 72.

Second test. No. 1, U. S. canteen, as issued by Ordnance Department. No. 2, Lanz canteen. No. 3, Improved Lanz canteen. Temperature of water at time of filling each canteen, 55 Fahrenheit. Canteens suspended at rest and exposed for 5 hours to a temperature of 135. The exterior surface of each canteen was dry before, and

during, the test. Results: No. 1, U. S. military canteen, 114. No. 2, Lanz canteen, 90. No. 3, Improved Lanz canteen, 84.

Third test. No. 1, U. S. canteen, as issued by Ordnance Department. No. 2, Braided Lanz canteen, wet. No. 3, Braided Lanz canteen, dry. No. 4, Arizona canteen, cavalry size, dry. No. 5, Braided Lanz-Cowles canteen, granulated cork cased, dry. Temperature of water when each canteen was filled, 55 Fahrenheit. All canteens suspended remained at rest during test. Time of exposure to a temperature constantly of 136 Fahrenheit, 5 hours. Results: No. 1, U. S. canteen, 104. No. 2 Braided Lanz canteen, wet, 92 No. 3, Braided Lanz canteen, dry, 94. No. 4, Arizona canteen, cavalry size, dry, 92. (Memorandum: The quantity of water in the Arizona canteen was double that placed in any of the other canteens.)

Mr. Lanz has, he states, tested made coffee, also tea, just off the fire, in his canteens, and then placed them in an ice-chamber—and claims that for use in the winter season, Arctic regions, etc., the non-conducting properties of his canteens have demonstrated like superior relative value.

He states, also, that he has attached various canteens to men on the march, to horses, moving bicycles, railway cars, etc., thus assimilating to conditions of actual service, with results proving the superiority of his inventions. One of his canteens is made of corrugated material.

In this connection, attention is invited to my report, dated 20 Jan., 1899, from Headquarters, 1st Division, 2d Army Crops, Camp Mackenzie, Augusta, Ga., reiterating previous recommendation that canteens should be covered with felt, or wool, inside the canvas cover.

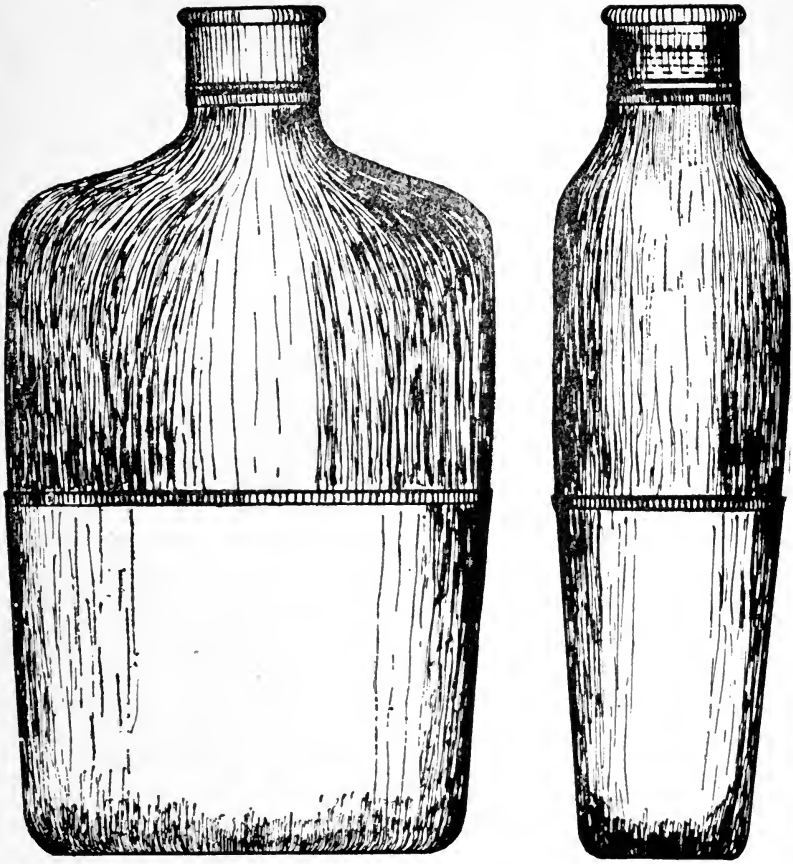
It is now recommended that whatever canteen be adopted—the flask be thoroughly covered with wool, felt, flannel, or by a non-conducting fabric, or substance.

The Lanz canteen is based on rational principles. The improvements in the service canteen have not kept pace with the developments in every other portion of the equipment or accoutrement of our soldiers; they have suffered needlessly because not provided with canteen which would keep water at a drinkable temperature in tropical regions and during the heated season.

Hence it is recommended that a thousand, or more, be ordered, for issue, trial, practical use in the field, and special reports.

Further, that the attention of the Chief of Ordnance, also of the Board of Fortification, Ordnance, and Equipment, be invited to the device.

A defect of the U. S. canteen is that the covering will not retain



Metallic Flask, capacity 32 fluid oz. screw top. the lower half of the shell of the flask is removable for use as a drinking cup. Submitted by the Lanz Manufacturing Co, Chicago Ill.

moisture in hot weather, hence contents of canteen become unpalatable.

Mr. George Lanz claims:

1. In combination, a flask, a layer of low-heat-conducting character covering the flask, a waterproof envelope for such covering; a jacket of fibrous material superimposed upon the envelope and an openable cover of close woven textile fabric for the jacket.

2. In a canteen, in combination, a flask, a layer of granulated cork covering the flask, a waterproof envelope for such covering, a jacket of fibrous material superimposed upon the envelope, and a canvas cover for the jacket, such cover being composed of two sections joined together, in part, by lacing.

3. In a canteen, in combination, a flask, a jacket of uninterrupted absorbent material therefor, and an openable cover for the jacket made of close woven fabric.

4. He claims the herein described method of retarding the rise of temperature of a liquid in an environment of a relatively higher temperature consisting in enclosing the liquid in a flask moistening the exterior of the flask and retarding the evaporation of such moisture.

Some of his canteens are protected by felt 1-8 of an inch in thickness; some by 2-8-inch felt; some by 3-8-inch felt; some by 4-8-inch felt.

Some have 1-8-inch layer of granular cork; some 2-8-inch cork; some 3-8-inch cork layer next the flask.

Some have both felt and cork of varying thickness over the flask —but all of the patterns of Lanz canteens have outside, the canvas laced up, openable cover. He claims to use only the best imported piano felt.

At Camp Lake View, Minn., during the week 19th to 27th July, 1900, some tests of the Lanz canteen as compared with the U. S. canteen as at present issued by the Ordnance Department, U. S. A., were made by Asst. Surgeon Asa Friend Goodrich, Medical Corps, N. G. S. M., and 1st Lieut. Wm. Arthur Carleton, 1st Regt. Infantry, N. G. S. M.

The Lanz canteen was the property of Capt. Wm. H. Hart, Brigade Quartermaster, Minnesota National Guard.

I was present at some of the tests and loaned what I call my Arizona canteen to be tested with the other canteens named.

One of the tests involved carrying a canteen attached to the saddle and carried for several hours in a hot sun on a horse in such a manner as to receive warmth from the body of the horse.

The following is a copy of the endorsement of the Lanz canteen by Capt. W. H. Hart. Reports were also made by Dr. Goodrich and Lieut. Carleton:

"Camp Lake View, Lake City, Minn., July 29, 1900. Mr. George Lanz, Manufacturer and Patentee Lanz Canteen, 183 Lake Street, Chicago, Ill. Sir: I am satisfied that when a metal flask containing water is covered with felt that has been saturated with water and the felt then covered with canvas that is laced up tight so as to minimize the access of air, the retarded evaporation operates to keep the contents of the flask palatably cool for a longer period, and at a lower temperature, than by any other process known to me. The higher the atmospheric temperature the better, so long as the felt is kept moist.

"You sent me for test and trial one of your canteens. The flask held about forty-five (45) fluid ounces. It had a layer of granulated cork stuck on to canvas and varnished, I think. Over that layer was a felt cover about a quarter of an inch thick. Over that was an openable canvas cover laced up like Colonel Reade's.

"The Government canteen cover is of flimsy material and cannot absorb nearly as much water as a canteen covered with fine piano all-wool felt.

"I caused two officers of the Minnesota National Guard to conduct a series of tests of your canteen at this place a few days ago, as compared with the U. S. Government canteen as issued by the Ordnance Department, U. S. A.

"Col. Reade's canteen, the one he used in June-August, 1898, in Santiago de Cuba, was borrowed for comparative test by these two officers. His canteen was covered with common saddler's felt covered with a laced canvas cover.

"Every care was exercised to make the conditions uniform; all canteens were filled at the same time; quantity of water in each the same; immersed fairly; same exposure; one thermometer used in testing.

"My personal judgment is based upon the results of those tests, and you can refer to me as one who condemns the present Government canteen and would like to see it superseded by the Lanz canteen.

"For what sum per hundred can you recover, by your process, the U. S. canteens now in the hands of the Minnesota National Guard?

"(Signed.)

W. H. Hart,

"Captain and Brigade Quartermaster,

"National Guard, State of Minnesota."

In witnessing these tests, several questions were in my mind: For use in tropical regions—

1. Did the inner cork jacket of one form of Lanz canteen do any good?

2. Did the waterproof layer (oilcloth, resin, cement, or varnish), whatever the substance might be, used to protect the inner layer, do any good?

3. Was the Lanz theory of having next to the flask a layer of material having low heat-conducting properties covered with a waterproof substance in order to prevent water from gaining access to the cork jacket, correct?

4. If the inner jacket, so isolated, aided to keep the contents of the flask palatable, was it commensurate with the enhanced cost and weight?

5. Would it not be better to discard this inner jacket and substitute a like amount in weight of fibrous or textile material, as in the Arizona canteen which has the felt material applied directly to the flask?

Using five (5) Lanz canteens, and two (2) U. S. A. canteens, as issued by the Ordnance Department, I have since witnessed the following test:

No. 1, Lanz canteen, cover 3-8-inch gran. cork; also 3-8-inch felt and canvas cover.

No. 2, Lanz canteen, cover 1-8-inch gran. cork; also 2-8-inch felt and canvas cover.

No. 3, Lanz canteen, cover 1-8-inch gran. cork; also 3-8-inch felt and canvas cover.

No. 4, Lanz canteen, cover, no gran. cork; 3-8-inch felt and also canvas cover.

No. 5, Lanz canteen, cover, no gran cork; 1-2-inch felt and also canvas cover.

Nos. 7 and 8, U. S. Government canteens as issued at present.

The seven canteens were filled with water of the same temperature—66 degrees F., and at the same time.

Quantity of water in each Lanz canteen, one 45, one 46 ounces.

All seven canteens were immersed in water for the same length of time—about fifteen minutes—after the lacing of each of the Lanz canteens had been loosened.

The laces in the Lanz canteens were then tightened up again and all seven canteens suspended above the roof of a four-storied building, where full circulation and exposure to air, light and heat, without contact, was maintained for six (6) consecutive hours. Beside

each canteen hung a thermometer, from which hourly readings were taken and outside temperature noted and recorded.

At 9 o'clock a. m., temperature was 90 degrees F.
At 10 o'clock a. m., temperature was 94 degrees F.
At 11 o'clock a. m., temperature was 93 degrees F.
At 12 o'clock m., temperature was 97 degrees F.
At 1 o'clock p. m., temperature was 98 degrees F.
At 2 o'clock p. m., temperature was 99 degrees F.
At 3 o'clock p. m., temperature was 99 degrees F.

After these six (6) hours' exposure, the contents of the canteens showed temperature as follows (a thermometer had been inserted in each canteen):

Lanz canteen, No. 1, 77 degrees F.
Lanz canteen, No. 2, 78 degrees F.
Lanz canteen No. 3, 78 degrees F.
Lanz canteen, No. 4, 78 degrees F.
Lanz canteen, No. 5, 77 degrees F.
U. S. canteen, 100 degrees F.
U. S. canteen, 102 degrees F.

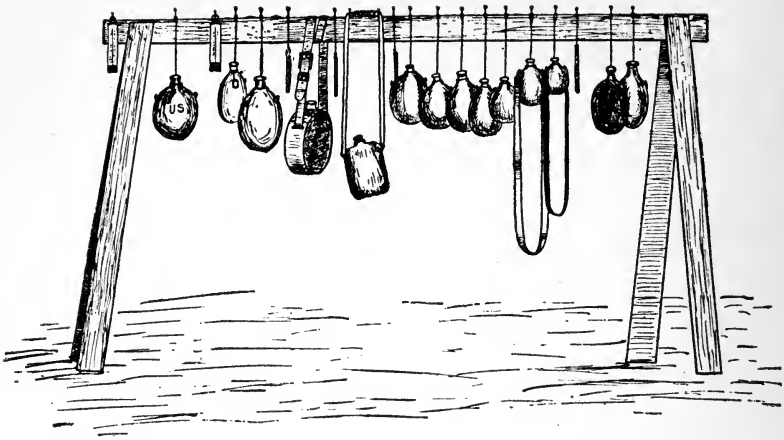
On another occasion, three (3) canteens were tested, viz.:

Lanz canteen, No. 1.
Lanz canteen, No. 4.
U. S. Government canteen as issued.

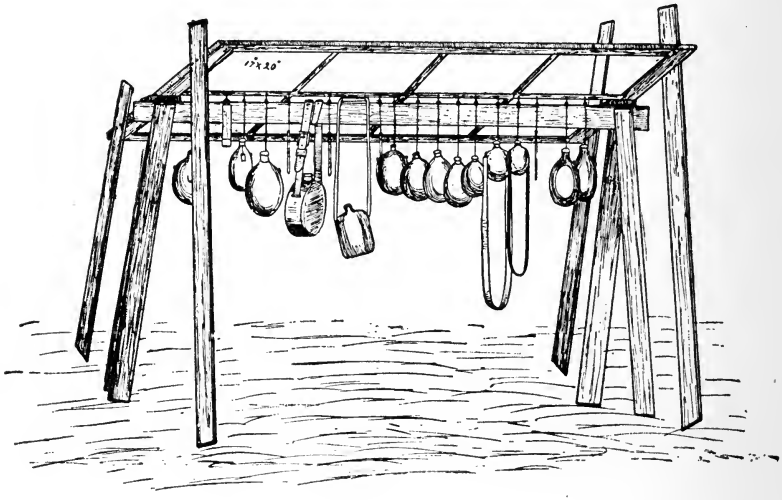
These three canteens were filled with water, 66 degrees F., and placed on the roof of a high building, so that one flat side of each canteen was exposed to the sun for seven (7) consecutive hours, from 8.30 a. m. to 3.30 p. m. A thermometer was placed beside each canteen and also inserted into each one after the seven hours' exposure.

The temperature was noted as follows:

8.30 a. m., outside temperature, 95 degrees F.
9.30 a. m., outside temperature, 105 degrees F.
10.30 a. m., outside temperature, 115 degrees F.
11.30 a. m., outside temperature, 120 degrees F.
12.30 p. m., outside temperature, 125 degrees F.
1.30 p. m., outside temperature, 125 degrees F.
2.30 p. m., outside temperature, 120 degrees F.
3.30 p. m., outside temperature, 115 degrees F.



Trestle showing open air method of testing canteens at Headquarters Department of Dakota, St. Paul, Minn.



Trestle showing open air method of testing canteens under glass 20'x17'x8 at Headquarters Dept. of Dakota St. Paul, Minn.

I have personally made the following tests, conducting same from my office, Army Building, St. Paul, Minn.

TEST No. 1.

Kind of Canteen.	Weight of Canteen. Dry oz.	Weight of Canteen. Wet oz.	Holds ounces.	Absorbent Capacity.	Temperature of Water when placed in Canteen.	Temperature of Water at Conclusion of Test.
No. 1, U. S. Government	16	17½	45	1½	76	90
No. 2, " "	15	18½	46	3½	76	92
No. 3, Lanz, single cork and ⅜-inch felt, canvas outside	25	40	45	15	76	76
No. 4, Lanz, ½-inch felt, canvas outside	24½	40	46	15½	76	76
No. 5, Reade, Arizona, saddler's felt, canvas outside	40	82	86	42	76	78

Outside temperature:— 9 a. m., 75 deg. F.
10 " 86 " F.
11 " 92 " F.
12 m., 94 " F.
1 p. m. 76 " F.
2 " 93 " F.
3 " 89 " F.

Canteens suspended over roof. The exterior cover of each canteen was wet before making the test. Time of exposure, at rest, six (6) hours.

TEST No. 2.

Kind of Canteen.	Weight of Canteen. Dry ozs.	Weight of Canteen. Wet ozs.	Holds ounces	Absorbent Capacity.	Temperature of Water when placed in Canteen.	Temperature of Water at Conclusion of Test.
No. 1, U. S. Government	16	17½	45	1½	64	89
No. 2, " "	15	18½	46	3½	64	89
No. 3, Lanz, single cork and ⅜-inch felt, canvas outside	25	40	45	15	64	78
No. 4, Lanz, ¼-inch felt, canvas outside	24½	40	46	15½	64	78
No. 5, Reade, Arizona, saddler's felt, canvas outside	40	82	86	42	64	76
No. 3, Lanz, XXX tin, single cork, ⅛-inch with waterpoof covering, ⅜-inch felt. (Loaned by Dr. A. F. Goodrich)	24	34½	45	10½	64	76
No. 4, Lanz, XXXX tin, ⅜-inch felt, no cork, canvas cover. (Loaned by Dr. A. F. Goodrich)	22	30	45	8	64	80

Outside temperature:— 9 a. m., 80 deg. F. 1 p. m., 90 deg. F.
10 " 74 " F. 2 " 93 " F.
11 " 83 " F. 3 " 92 " F.
12 m., 90 " F.

Canteens suspended at rest, above roof, where free circulation and exposure to sunlight and heat, without contact, was maintained for six (6) consecutive hours. The outer, or canvas, cover was saturated before making the test.

TEST No. 3.

Kind of Canteen.	Weight of Canteen. Dry ozs.	Weight of Canteen. Wet ozs.	Holds ounces.	Absorbent Capacity.	Temperature of Water when placed in Canteen.	Temperature of Water at Conclusion of Test.
No. 1, U. S. Government					72	94
No. 2, " "					72	96
No. 3, Lanz,					72	78
No. 4, "					72	76
No. 5, Reade, } As described in Test No. 2	As	in	Test	No. 2.	72	80
No. 3, Lanz,					72	78
No. 4, "					72	75

Outside temperature:— 8 a. m., 76 deg. F. 1 p. m., 93 deg. F.
9 " 82 " F. 2 " 92 " F.
10 " 90 " F. 3 " 90 " F.
11 " 92 " F. 4 " 88 " F.
12 m., 93 " F.

Canteens suspended at rest above roof, where free circulation and exposure to sunlight, without contact with one another, was maintained for eight (8) consecutive hours. Covers were wet before making test.

TEST No. 4.

Kind of Canteen.	Weight of Canteen. Dry ozs.	Weight of Canteen. Wet ozs.	Holds ounces.	Absorbent Capacity.	Temperature of Water when placed in Canteen.	Temperature of Water at Conclusion of Test.
No. 1, U. S. Government					78	92
No. 2, " "					78	93
No. 3, Lanz,					78	77
No. 4, "					78	76
No. 5, Reade, } As described in Test No. 2	As	in	Test	No. 2.	78	76
No. 3, Lanz,					78	76
No. 4, "					78	76

Outside temperature, and temperature of water, each hour, in each canteen, during Test No. 4.

Hour.	Outside Temperature	CANTEEN. No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 3.	No. 4.
8 a. m.	72	78	78	78	78	78	78	78
9 "	83	75	76	78	78	74	77	78
10 "	85	78	75	78	78	76	76	78
11 "	86	76	76	76	76	74	76	78
12 m	87	77	79	77	76	76	76	78
1 p. m	89	82	86	76	76	75	75	76
2 "	88	89	91	76	76	73	75	76
3 "	88	92	92	77	76	76	75	76
4 "	88	92	93	77	76	76	76	76

Canteens suspended at rest above roof, where free circulation and exposure to sunlight, without contact with one another, was maintained for eight (8) consecutive hours. Covers were dry before making test.

TEST No. 5.

Kind of Canteen.	Weight of Canteen. Dry ozs.	Weight of Canteen. Wet ozs.	Holds ounces.	Absorbent Capacity.	Temperature of Water when placed in Canteen.	Temperature of Water at Conclusion of Test.
No. 1, U. S. Government					80	104
No. 2, " "					80	103
No. 3, Lanz,					80	*
No. 4, "					80	80
No. 5, Reade, } As described in Test No. 2.	As	in	Test	No. 2.	80	81
No. 3, Lanz,					80	80
No. 4, "					80	80
No. 1A, U. S. Government	14	20	48	6	85†	90
No. 2A, " "	14	20	48	6	85†	90
No. 3A, " " ‡	14	20	48	6	85†	86
Tin Flask (not covered)			48	6	85†	92

*Contents spilled before conclusion of test.
†These canteens were exposed one hour only, from 3 to 4 o'clock p. m.
‡Canteen No. 3 A, is a U. S. Government canteen having a leg of a woolen stocking pulled over its covering.

Outside temperature, and temperature of water, each hour, in each canteen, during Test No. 5.

Hour.	CANTEEN. Outside Temp.	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 3.	No. 4.	No. 1A.	No. 2A.	No. 3A.	Tin Flask
8 a. m.	79	80	80	80	80	80	80	80				
9 "	84	78	78	79	80	80	79	78				
10 "	88	78	78	78	80	80	79	78				
11 "	91	80	79	80	80	80	80	80				
12 m.	94	81	83	80	82	81	81	82				
1 p. m.	100											
2 "	100											
3 "	100	102	103		82	82	81	81	85	85	85	85
4 "	97	104	103		80	81	80	80	90	90	86	92

Wind, ten miles an hour during this test. Canteens were in constant motion. Four ounces of water taken from each canteen every hour for the first four hours.

TEST No. 6.

Kind of Canteen.	Weight of Canteen. Dry ozs.	Weight of Canteen. Wet ozs.	Holds ounces.	Absorbent Capacity.	Temperature of Water when placed in Canteen.	Temperature of Water at Conclusion of Test.
No. 1, U. S. Government					76	98
No. 2, " "					76	98
No. 3, Lanz,					76	82
No. 4, "					76	80
No. 5, Reade, } As described in Test No. 2	As given in Tests				76	80
No. 3, Lanz,	Nos. 2 and 5.				76	82
No. 4, "					76	82
No. 1A, U. S. Government					76	98
No. 2A, " "					76	98
No. 3A, " "					76	84
Tin Flask (not covered)					76	98

Outside temperature, and temperature of water, each hour, in each canteen, during Test No. 6.

Hour.	Outside Temp.	CANTEEN.										
		No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 3.	No. 4.	No. 1A.	No. 2A.	No. 3A.	Tin Flask.
8 a. m...	83	76	76	76	76	76	76	76	76	76	76	76
9 " ...	78	72	72	74	74	75	76	74	78	74	74	80
10 " ...	82	72	72	74	74	75	75	75	80	75	74	84
11 " ...	86	74	75	74	75	75	75	76	82	78	74	86
12 m.....	86	78	82	74	75	75	75	76	85	82	74	86
1 p. m...	90	84	84	76	76	76	76	77	86	86	76	89
2 " ...	92	89	90	78	78	77	78	79	90	90	80	92
3 " ...	94	94	94	80	80	78	80	82	92	94	82	94
4 " ...	92	98	98	82	80	80	82	82	92	98	84	98

During Test No. 6, all of the canteens were constantly in motion, due to the wind. Every hour each canteen was dipped and four (4) ounces of water poured out; thus the quantity of water in each canteen was hourly reduced in bulk.

The advantage of the cork and felt combined as opposed to an equal thickness of felt covering is scarcely appreciable.

Further Experimental Tests Made With the U. S. Canteen and the Lanz Canteen.

Tests by Second Lieutenant F. W. Healy, Eighth Infantry, and by A. A. Surgeon R. M. Fletcher, Jr.:

Lieut. F. W. Healy, Eighth Infantry, filled a canteen, patented by Mr. William Lanz, 183 Lake street, Chicago, Ill., with water; temperature, 56 degrees F.

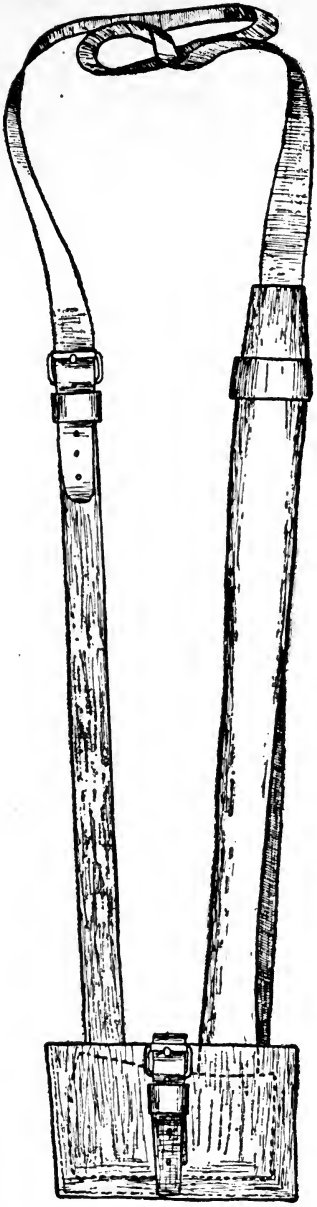
The canteen was then placed against the wire fender, or spark arrester, screening the wood fire of the open fire-place, and allowed to remain there for ten (10) hours.

At the expiration of that time the temperature of the water in the Lanz canteen was found to be 70 degrees. A Government canteen, similarly exposed, had a temperature of 82 degrees.

On the following day, Lieut. Healy tested the Lanz canteen, also a canteen, Ordnance pattern, issued to a member of Company D, Eighth U. S. Infantry, in the following wise:

Each canteen was immersed in water, temperature, 56 degrees F., for about two minutes, and each canteen was then filled with water of the temperature named. The capacity of the Lanz canteen was 46 fluid ounces; that of the Government canteen 47 ounces.

They were then placed so as to receive in equal proportion the direct action of a wood fire burning in the fire-place of the quarters occupied by Lieut. Healy.



Scale 1/3

Small axe and leather sling and sheath for its carriage on the person.

Four hours later the temperature of each canteen was taken by Acting Assistant Surgeon R. M. Fletcher, Jr., Post Surgeon, Fort Assinniboine, with the following results, viz.: Lanz canteen, 70 degrees; Government canteen, 74 degrees.

The canteens were then thrown into an army wagon and transported up Beaver Creek, ten miles and back; in all, twenty (20) miles.

The difference in temperature was then found to be twelve (12) degrees, the Lanz canteen being the lower temperature.

The canteens were used on the following day by a party of duck hunters and jolted around for several hours in the sun. The difference in temperature was found to be twelve (12) degrees, the Lanz canteen containing the more palatable water.

I am informed that when the application for the Lanz patent No. 655979, August 15, 1900, was pending, the Patent Office cited, as reference against the claims, the following patents:

British patents to Blakeny, 1163 of 1884;

British patents to Sothcott, 2453 of 1878;

Italian patents to Bouffier, 10397 of June 23, 1879;

American patent to Hiramo W. Hanmore, White Plains, N. Y., 296955; April 15, 1884;

American patent to Brauer, 244374, July 19, 1881.

The two American patents are said to be of the least importance, relating simply, Hanmore, to a water cooler comprising a can having its bottom and side walls covered with "a non-conducting covering of raw silk waste and calcined or carbonate of magnesia," and an outer jacket of wood; and, Brauer, to an ice-house, or ice-box, or refrigerator, in box form, and having hollow walls packed with granular cork, and having an outer wall for enclosing an air space.

The Sothcott patent showed a flask encased in either felt or leather. The low conductivity of the cover was the reliance, the patentee not depending upon evaporation and not rendering it possible to practice this method of cooling when he used a leather cover, and not making any provision for retarding the evaporation should he saturate the felt cover

The Bouffier patent discloses a flask having a covering of tresses, or braids, of cellular sea weed, straw or paper pulp, including a quantity of air, and an outer covering of cotton or linen cloth, or this outer covering may be of felt or rubber and made detachable for cleaning purposes.

The drawings of this patent show a familiar structure, but it

appears that the principle of action depended upon is entirely different, the patentee depending simply upon the low conductivity of the material used, and of the air enclosed within its cells, for keeping the contents of the canteen cool. The patent gives no hint of an evaporating process, nor does it describe a construction which provides for the practicing of any such method should it be desired.

The Blakeny patent shows a flask, preferably of glass, having an inner covering of felt, and an outer covering of leather, and this outer cover is shown as secured by lacing.

No advantage can be secured from a Blakeny evaporation process in a structure made after the specification of this patent, for the reason that the leather cover practically wholly prevents evaporation.

It is claimed that in all other cases, except the Lanz, means were provided for stimulating, rather than retarding, evaporation.

The only devices known to me for securing the cooling action by evaporation may be divided into three classes, viz.:

1. Those in which an outer envelope is saturated by a single application of moisture, as by dipping or sprinkling, and is then allowed to dry out. The present regulation army canteen is an example of this class.

2. Those in which an outer envelope is continuously saturated by capillary action, a reservoir being supplied from which water is drawn by the fabric of which the envelope is composed.

3. Those in which the receptacle itself has porous walls through which the liquid contents of the receptacle exude.

A distinction between the Ordnance pattern army canteen and the Lanz canteen is, that one has its cover permanently attached, and the other has its cover openable. Owing to this difference, there results a different principle of action in practical use of the two devices. It is impracticable to easily thoroughly saturate the one, thus failing to secure the benefits of a prolonged evaporative action. In the other it is entirely practicable to thoroughly saturate by simply unlacing the cover and dipping the canteen and then replacing it.

Instances of the second type of coolers, in which there is a continuous water feed to the jacket, are found in the following U. S. patents:

Bernhard Moobius, 296432, April 8, 1884, Chihuahua, Mexico.

James Goddard Lamb, 568259, Sept. 22, 1896, Wellington, New Zealand.

Kingston Gordon, 149852, April 21, 1874, Richmond, N. Y.

John Rutten, 102595, May 3, 1870, West Chester, Pa.

Albert McDowell, 424125, March 25, 1890, Selma, Cal.

In none of these instances is the idea of retarding evaporation present; on the contrary, means are provided for stimulating it. Most contain suggestions that the device should be located in such position that there will be a circulation of air about it so that evaporation may be permitted.

The third type of coolers is found in the following patents:

William Morrow and William Symington, 415366, Nov. 19, 1889, Kansas City, Mo.

Richard Kelly, 135432, Feb. 4, 1873, Red Bank, Cal.

Charles G. Jordan, 273097, Feb. 27, 1883, Catlin, Col.

Valentine Stuyvesant, 419230, Jan. 14, 1890, Denver, Col.

Jahon V. Frost, 556744, March 24, 1896, Los Angeles, Cal.

The Frost shows a cooler made of porous material, such as terra cotta, so that its liquid contents may seep through its walls, which are covered with asbestos. This patent shows an effort to retard evaporation by covering the asbestos with a layer of wool twisted into cords and wound thereabout. It is not a removable cover, and, if applied to a canteen, would operate on a principle different to the Lanz.

Other patents are:

(a) British patent to Cochran, 508, of 1869.
(b) British patent, to Johnson, 1972, of 1888.
(c) American patent, to Lazare, 36641, of Oct. 14, 1862.
(d) American patent, to Beers, 32541, of June 11, 1859.
(d) American patent, to Bournum, 37273.
(e) American patent, to Heneage, 31154.
(f) American patent, to Pilger, 275697.
(g) American patent, to Roumillat, 222158.
(g) American patent, to Tunnions, 59875.
(h) American patent, to Farciot, 46094.
(h) American patent, to Bartholomae, 32744.
(i) British patent, to Sombart, 5963, of 1883.
(j) British patent, to Girrard, 12792, of 1889.
(a) Flask with either felt or leather jacket. Low conductivity of the jacket only reliance for cooling action.
(b) Flask with tightly fitting canvas cover.
(c) Canteen made of leather, rendered waterproof, lined with tinfoil.
(d) Both relate to canteens made of wood and without covering.
(e) Compartment canteen.
(f) Relates to construction of bucket. No outer cover.

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(g) Both relate to stoppers for bottles or canteens, or the like.
(h) Relate to the form of canteen.
(i) Flask covered with an absorbent material adapted to be saturated from which there may be free saturation.
(j) Cooler with a felt jacket, which dips into an ice or water-filled receptacle, so as to carry the moisture up by capillary action. No provision is made for retarding the evaporation.

None of the patents herein discussed contain claims which dominate the Lanz canteen, and my conclusion is that the latter does not infringe any existing patent and that the rational, mechanical and physical principle upon which it is constructed make it advisable to purchase a thousand or more for test and report at the hands of troops now serving in tropical or arctic regions.

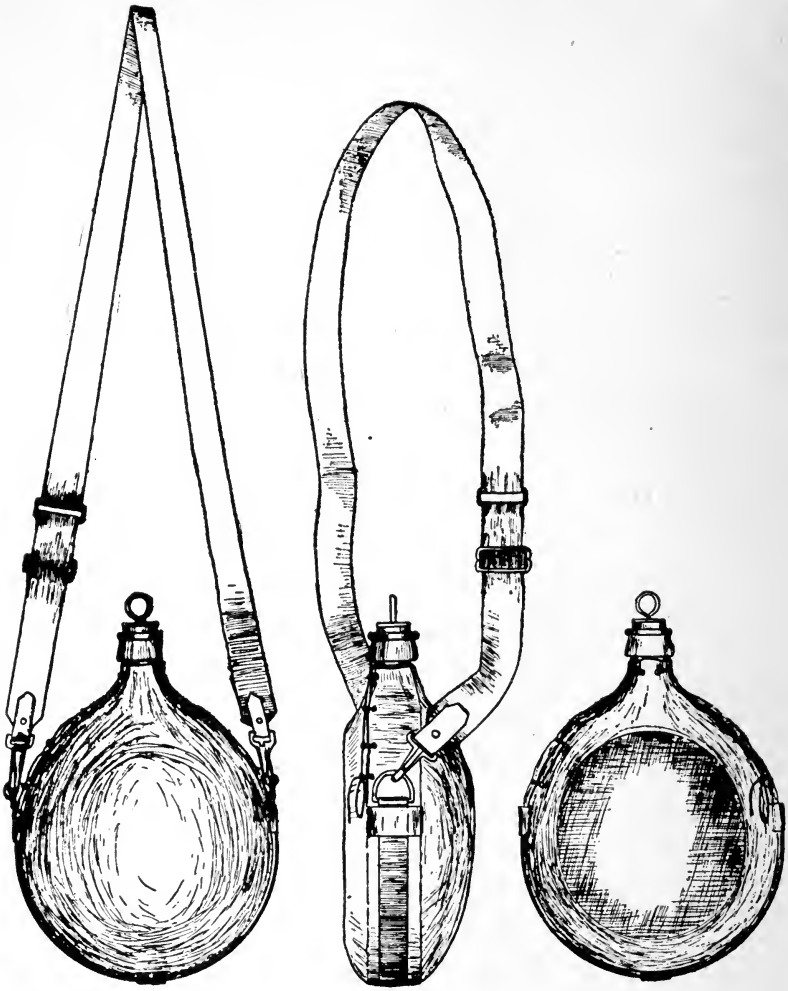
Tests Made at Fort Meade, S. D.

On Oct. 26, 1900, the Post Surgeon, Fort Meade—Samuel Melville Waterhouse, Medical Dept., U. S. A.—began experimental tests using the Government canteen, as issued by the Ordnance Dept., U. S. A., and the Lanz canteen, patent of William Lanz, 183 Lake St., Chicago, Ill.

Test No. 1.

Weight of tin flask of Government canteen, empty, 12 ounces.
Weight of Government canteen, complete, dry, 15 ounces.
Weight of Lanz canteen, dry, 17 ounces.
Capacity, fluid ounces, of Government canteen, 48 ounces.
Capacity, fluid ounces, of Lanz canteen, 40 ounces.
Weight of Government canteen, after thorough immersion, 17 ounces.
Weight of Lanz canteen after thorough immersion, 23 ounces.
Weight of felt covering of Government canteen, dry, 1 ounce.
Weight of felt covering of Government canteen, wet, 6 ounces.
Weight of duck covering of Government canteen, dry, 2 ounces.
Weight of duck covering of Government canteen, wet, 3 ounces.
Temperature of water when put into the canteens, 56 degrees F.
Both the canteens were then placed in a hot air sterilizer used as an incubator, in separate compartments, at 40 degrees C., equivalent to 100 degrees F.

After an exposure of one hour, the temperature of water in each canteen was as follows: Government canteen, 95 degrees F. Lanz canteen, 88 degrees F.



U

Karlsruhe, Baden, Germany. Alumium Flask, covered by the Lanz method with 3/8 inch Amsterdam sponge felt; openable canvas cover, cut in three pieces, high collar. Capacity 42 fluid oz., Wt. 17 oz.

TEST NO. 2.

The canteens were then replaced in the incubator at the same temperature as above, and at the expiration of another hour, temperature was as follows: Government canteen, 102 degrees; Lanz canteen, 95 degrees.

After another hour of similar exposure the temperature was: Government canteen, 132 degrees; Lanz canteen, 118 degrees.

TEST NO. 3.

Both canteens dry, no immersion, were filled with water at a temperature of 147 degrees and placed in a cold storage room where the uniform temperature of 38 degrees F. existed.

Observations—After first hour, Government canteen, 110 degrees, F.

After first hour, Lanz canteen, 116 degrees, F.

After second hour, Government canteen, 90 degrees F.

After second hour, Lanz canteen, 108 degrees F.

After third hour, Government canteen, 74 degrees F.

After third hour, Lanz canteen, 97 degrees F.

TEST NO. 4.

Conditions—The canteens were filled with water, the temperature of which was 50 degrees, and immersed until the covers were saturated. They were then placed in a hot air sterilizer, the door of which was kept open. The thermometer directly in contact with the hot air registered a temperature of 127 degrees almost uniformly.

The observations were as follows:

After a lapse of one hour the temperature was, Government, 70 degrees; Lanz, 66 degrees.

After the lapse of two hours, the temperature was, Government, 78 degrees; Lanz, 72 degrees.

After the lapse of three hours, the temperature was, Government, 82 degrees; Lanz, 76 degrees.

TEST NO. 5.

Conditions of this test were as follows: Canteens were immersed in water till covers were thoroughly saturated.

Forty (40) ounces of water of 56 degrees F. was placed in each canteen. The canteens were then suspended four inches above a radiator in the hospital, Fort Meade, S. D., for eight (8) hours and the radiated heat maintained for that period between 95 degrees F. and 98 degrees F.

For the last two exposures the canteens were placed in direct contact with the radiator, a uniform temperature of 99 degrees F. being maintained.

The observations, made hourly, show the following:

Expiration of the first hour, 10:45 a. m., Government canteen, 60 degrees F.; Lanz canteen, 60 degrees F.

Expiration of the second hour, 11:45 a. m., Government canteen, 62 degrees F.; Lanz canteen, 62 degrees F.

Expiration of the third hour, 12:45 p. m., Government canteen, 63 degrees F.; Lanz canteen, 63 degrees F.

Expiration of the fourth hour, 1:45 p. m., Government canteen, 64 degrees F.; Lanz canteen, 64 degrees F.

Expiration of the fifth hour, 2:45 p. m., Government canteen, 64 degrees F.; Lanz canteen, 64 degrees F.

Expiration of the sixth hour, 3:45 p. m., Government canteen, 66 degrees F.; Lanz canteen, 65 degrees F.

Expiration of the seventh hour, 4:45 p. m., Government canteen, 74 degrees F.; Lanz canteen, 68 degrees F.

Expiration of the eighth hour, 5:45 p. m., Government canteen, 86 degrees F.; Lanz canteen 70 degrees F.

Under ordinary circumstances the Government canteen will keep water as cool as the Lanz for some hours; but after the water absorbed by the U. S. canteen has evaporated, the Lanz will keep water at a lower temperature than the U. S. canteen.

Test Made at Fort Snelling, Minn.

By Captain A. E. Bradley, Asst. Surgeon, U. S. A., Post Surgeon, with the U. S. A. canteen as issued by the Ordnance Dept., and the Lanz canteen, patented by William Lanz, 183 Lake St., Chicago, Ill., Nov. 7 to 13, 1900:

Data:

Weight of the felt covering, 1 ounce.

Weight of the canvas covering, 2 ounces.

Weight of the felt covering, 6 ounces.

Weight of the duck covering, 3 ounces.

Weight of the tin flask, 10 to 11 ounces.

Weight of Government canteen, dry, 13 to 15 ounces.

Weight of Government canteen, with covers on, after immersion 10 minutes, 14 ounces.

Weight of Government canteen, with covers on, after immersion 12 hours, 18 ounces.

Capacity of the Government canteen, 42 to 47 ounces.

Weight of the Lanz canteen, dry, 16 ounces.

Weight of the Lanz canteen, wet, 10 minutes' immersion, 22 ounces.

Capacity of the Lanz canteen, 42 ounces.

Weight of canvas cover, Lanz canteen, dry, 3 ounces.

Weight of canvas cover, Lanz canteen, wet, 4 ounces.

EXPERIMENT No. 1.

Time and conditions of exposure.—The canteens being filled with water, temperature 54 deg., F., were suspended above a direct-indirect radiator for eleven (11) hours, and temperature of air and each canteen taken hourly. During the succeeding two (2) hours the canteens were placed in contact with the radiator. The following results were obtained, the same thermometer being used:

Time.	TEMPERATURE. Air.	Govt. Canteen. All Wet.	Lanz Canteen. All Wet.	Lanz Canteen. Wet.
8 a. m	66	54	54	54
9 "	70	56	56	54
10 "	72	57	57	58
11 "	72	58	57	59
12 m	86	60	59	62
1 p. m	80	61	59	62
2 "	72	59	58	62
3 "	73	58	58	62
4 "	67	57	57	62
5 "	68	57	57	61
6 "	72	58	57	62
At 6 o'clock the canteens were placed in	direct	contact	with ra	diator:
7 p. m	73	72	66	69
8 "	80	82	70	74
EXPERIMENT	**No. 2.**			
Conditions same as in Ex	periment	No. 1.		
1 p. m	84	56	56	56
2 "	86	60	59	56
3 "	96	63	63	63
4 "	89	64	65	66
5 "	94	70	66	68
6 "	92	72	66	68
7 "	92	73	66	68

EXPERIMENT No. 3.

The canteens, being filled with water, temperature 54 deg., were suspended above the kitchen range in the hood designed to carry off odors from the kitchen, and observations made hourly:—

Time.	TEMPERATURE. Air.	Govt. Canteen. All Wet.	Lanz Canteen. All Wet.	Lanz Canteen. Wet Felt.
8 a. m	120	56	56	56
9 "	110	84	82	74
10 "	130	110	104	94
11 "	200	128	108	102

EXPERIMENTS Nos. 4 and 5.

In these experiments the canteens were placed in an incubator and observations made hourly. The average temperature of the incubator, a closed box, was 90 deg., F. The results showed practically the same temperature at all hours for all canteens.

EXPERIMENT No. 6.

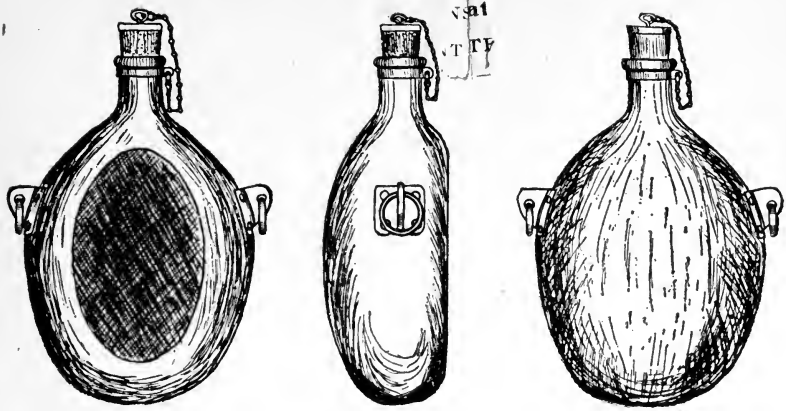
A Government canteen and a Lanz canteen were thoroughly wet, and filled with water, temperature 58 deg., F. They were placed side by side on blocks of wood in an oven of the kitchen range, not touching the sides of the oven. The door was left open. The following observations were noted:—

Time.	TEMPERATURE.		
	Air.	Govt Canteen.	Lanz Canteen.
10 a. m	300	58	58
11 "	324	151	98
12 m	284	188	111

EXPERIMENT No. 7.

Three Government canteens and one Lanz canteen, coverings, of all, dry, were suspended out of doors in a tree about thirty feet from the hospital. At 10 o'clock a. m., temperature of air 40 deg., F., they were filled with hot water, temperature 126 deg., F. Hourly observations were made as follows:—

Time.	TEMPERATURE.				
	Air.	Government Canteens.			Lanz Canteen.
		No. 1.	No. 2.	No. 3.	
10 a. m	40	126	126	126	126
11 "	41	98	92	74	106
12 m	42	81	76	58	90
1 p. m	38	65	62	47	77
2 "	38	58	55	42	70
3 "	36	51	48	39	62
4 "	36	47	46	37	58



W

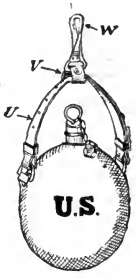
Karlsruhe Baden Germany. naked Aluminum flask – weight 9 oz. Single piece metal with steel rings attached to an aluminum lug, (each two pieces) riveted to the flask by means of two rivets. Submited by the Lanz Mfg. Co., 183 Lake st. Chicago, Ill. Capacity .44 fluid oz.

Scale: 1/3.

Scale: 1/2

Arrows show where leakage began

U.S. Army Regulation Service Canteen
Ordnance Pattern, Cover off.
Capacity 43. oz. Fluted face



Canteen and Strap for U.S. Cavalry as prescribed by G.O. 73. A.G.O. 1885. Manufactured by, or for, the Ord. Dept USA.

W: Snap Hook
V: Sliding Loop
U: Black Collar Leather

Open Air Tests Made at Headquarters Dept. of Dakota.

TEST No. 1.

Time.	TEMPERATURE.				
	Air.	Government Canteens.			Lanz Canteen.
		No. 1.	No. 2.	No. 3.	
10 a. m	40	126	126	126	126
11 "	41	98	92	74	100
12 m	42	81	76	58	90
1 p. m.	38	65	66	47	77
2 "	38	58	55	42	70
3 "	36	51	48	39	62
4 "	36	47	46	37	58

TEST No. 2.

Time.	TEMPERATURE.				
	Air.	Government Canteens.			Lanz No. 4.
		No. 1.	No. 1A.	No. 3A. Stocking Leg Over Canteen.	
9 a. m	16	172	172	172	172
10 "	18	112	122	126	132
11 "	18	78	88	96	102
12 m	20	58	68	78	90
1 p. m	18	46	54	64	76
2 "	18	36	44	54	64
3 "	18	32	38	46	56
4 "	19	32	32	40	50

TEST No. 3.

Time.	TEMPERATURE.					
	Outside.	U. S. Army Ord. Pattern. Capacity 43 ozs.**	Dubuque Stamp. & Enamel Co., Parker Filter Capacity 50 ozs.**	German Aluminum Flask. Capacity 25 ozs.**	Lanz Aluminum Flask. Capacity 44 ozs.**	Lanz Tin Flask. Capacity 36 ozs.**
9 a. m	5	175	175	175	175	175
10 "	4	126	104	96	154	156
11 "	6	78	50	44	138	122
12 m	6	50	32	32	112	102
1 p. m	8	34	32	32	94	86
2 "	9	34	*	*	79	70
3 "	9	32			64	60
4 "	10	32*			56	50

*Slush ice formed—frozen—withdrawn.
**Fluid (Troy) ounces, not avoirdupois.

A Preston Mess Kit was also included in Test No. 3, with following results:—

10 a. m....175 deg., F. 1 p. m....100 deg., 4 p. m....58 deg., F.
11 " ....162 " F. 2 " .... 82 " 5 " ....50 " F.
12 m.....124 " F. 3 " .... 70 "

Open Air Tests Made of Canteens and Canteen Flasks at Headquarters, Department of Dakota, Saint Paul, Minnesota.

To facilitate reference, the following alphabetical index is adopted.

A. —U. S. Army Regulation Service Canteen, Ordnance Pattern: Double Cover felt and canvas. Capacity, 43 fluid ounces. weight 14 ounces, avoirdupois. (See cut A.)

A-1. —U. S. Army Regulation Canteen; Double Cover felt and canvas. Capacity, 48 fluid ounces. Weight, empty, covers on and dry, 14 ounces, avoirdupois. Weight, empty, covers on and wet, 20 ounces, avoirdupois.

AA.—U. S. Army Regulation Canteen, manufactured at Rock Island Arsenal, 1900: Double Cover; inner of Petersham felt, outer of dyed duck or canvas. Capacity, 44 fluid ounces. Weight, covers on and dry, empty, 12 and ¾ ounces, avoirdupois. Weight of tin flask, without covers, empty, 9 and ½ ounces, avoirdupois.

B. —U. S. Army Regulation Service Canteen, Ordnance Pattern: Double Cover felt and canvas, having also a woolen stocking leg drawn over it. Capacity, 45 fluid ounces. Weight 16 ounces. (See cut B.)

BB.—Three views. (See cut BB.) Combination Canteen and Filter. Canteen is the regulation tin flask and double cover, made at Rock Island Arsenal, October, 1898, with a specially wide mouth to accommodate the Mrs. Caroline Parker filter. Capacity, filter in, 42 ounces, avoirdupois. Fluid ounces, 40. Weight, filled, filter in, filled, covers on and dry, 59 ounces, avoirdupois. Weight, filter in, filled, covers on, after ten (10) minutes' immersion, 64 ounces, avoirdupois. Weight of the tin flask, no cover, empty, filter out, 9 and ¾ ounces, avoirdupois.

C. —Dubuque Stamping & Enamel Co. Canteen (with Parker Filter in): No cover. Capacity, 50 ounces. Weight 22 ounces.

CC.—Seven views. (See cuts C, CC, CCC.) Enameled Metal Canteen Flask, bought by the U. S., January, 1900, from

Dubuque, Iowa, Enameling Co. Capacity, 44 and ¾ ounces. Weight, filled, covers on and dry, 64 and ¾ fluid ounces, avoirdupois. Weight, filled, covers on, after ten (10) minutes' immersion, 75 ounces, avoirdupois. Weight of the enameled flask, empty, no covers on, 16 and ¼ ounces, avoirdupois.

D. —Karlsruhe, Baden, Germany, Aluminum Flask: No cover. Capacity, 25 ounces. Weight, 5 ounces. (See cut D.)

E. —U. S. Army Regulation Service Tin Flask, Ordnance Pattern, no cover. Capacity, 45 ounces. Weight, 12 ounces. (See cut E.)

F. —Aluminum Flask, circular, made in Newark, N. J. Covered by the Lanz method, double cover, felt and canvas. Capacity, 44 ounces. Weight, 16 ounces. (See cut F.)

G. —Lanz Tin Flask Canteen, circular. Covered by the Lanz method, ½ inch felt and openable canvas cover. Capacity, 36 ounces. Weight, 25 ounces. (See cut G, four views.)

H. —Arizona Canteen. Covered with saddler's felt, also by several thicknesses of flannel, and an openable canvas cover, Lanz method. Capacity, 87 ounces. Weight, 34 ounces. (See cut H.)

I. —Preston Mess Kit, Complete. Double cover, felt and canvas. Capacity, 46 ounces. Weight, 37 ounces.

K. —Karlsruhe, Baden, Germany, Aluminum Flask. Covered by the Lanz method, ⅜ inch felt, and openable canvas cover. Capacity, 43 ounces. Weight, 15 ounces. (See cut K.)

L. —Karlsruhe, Baden, Germany, Aluminum Canteen, with carrying strap. Covered by the German method, single felt. Capacity, 60 ounces. Weight, 14 ounces. (See cut L.)

M. —Newark, N. J., Aluminum Canteen Flask, circular. No cover. No solder said to be used. Capacity, 48 ounces. Weight, 8 ounces.

MM.—Newark, N. J., Aluminum Canteen, oblong shape, no seams or solder said to be used. Weight of naked flask, 9 and ¼ ounces. Capacity, 42 fluid ounces. Weight, filled, cover on and dry, 56 ounces, avoirdupois. Removable single

cover, felt, laced up on one side only, Lanz method; high collar.

N. —Newark, N. J., Aluminum Circular Canteen Flask. No cover. No solder said to be used. Capacity, 32 ounces. Weight, 6 and ½ ounces.

NN.—Newark, N. J., Aluminum Canteen, oblong shape, no seams or solder said to be used, identical with "MM" except capacity. Weight of naked flask, 7 and ¼ ounces. Capacity, 38 and ½ fluid ounces. Weight, dry, cover on, empty, cork in, 8 and ¼ ounces, avoirdupois. Weight, filled, cover dry, 49 ounces avoirdupois. Single cover same as "MM."

O. —Newark, N. J., Aluminum Circular Canteen Flask. No cover. No solder said to be used. Capacity, 16 ounces. Weight, 3 and ¼ ounces. (See cut O.)

P. —Reymond and Gottlob Aluminum Canteen. Single felt cover. Capacity, 29 ounces. Weight, 8 ounces. (See cut P, four views.)

Q. —Lanz Tin Flask Canteen. Covered by Lanz method, ½ inch felt, and openable canvas cover. Capacity, 45 fluid ounces. Weight, 19 ounces. (See cut G, four views.)

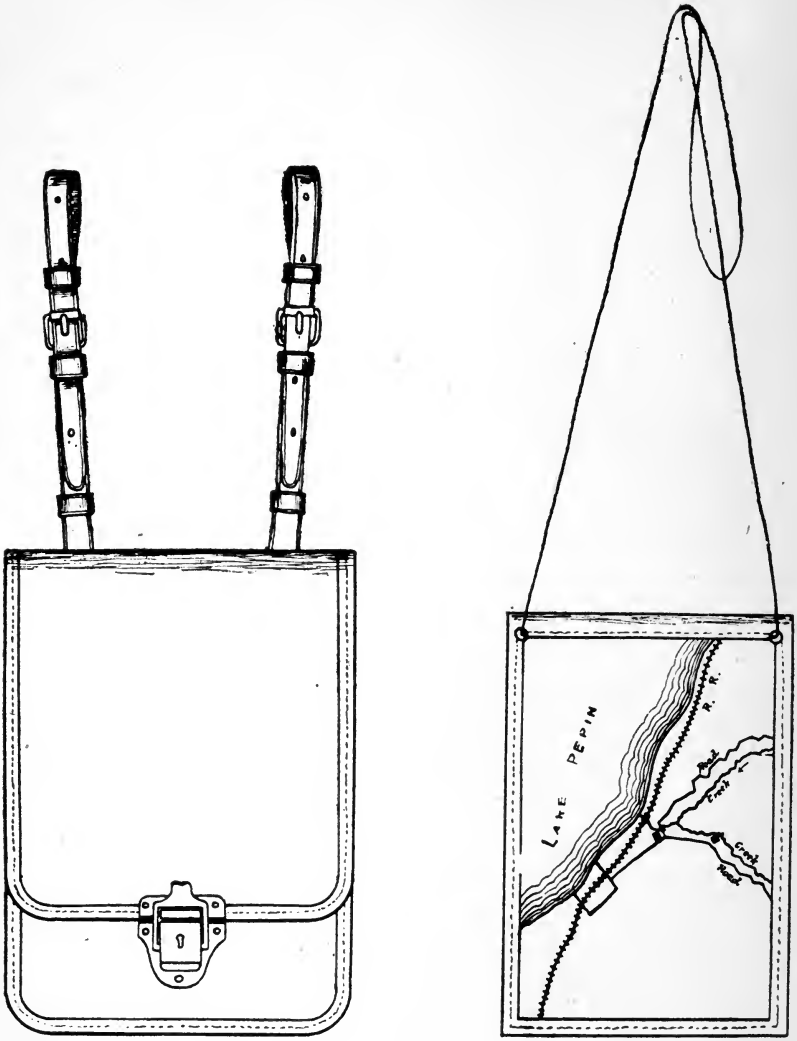
R. —Karlsruhe, Baden, Germany, Aluminum Flask. Covered by the Lanz method, 4-8 inch wool felt, and openable canvas cover. Capacity, 45 fluid ounces. Weight, 15 ounces.

S. —Lanz Circular Canteen. Tin Flask. Covered by the Lanz method, 4-8 inch wool felt, and openable canvas cover. Capacity, 39 ounces. Weight, 19 ounces. (See cut G, four views.)

T.—Lanz Circular Canteen. Tin Flask. Covered by the Lanz method. 4-8 inch Amsterdam sponge woven felt, and openable canvas cover, three pieces canvas, high collar. Capacity, 39 ounces. Weight, 19 ounces.

U. —Karlsruhe, Baden, Germany, Aluminum Flask. Covered by the Lanz method, ⅜ inch Amsterdam sponge woven felt, and openable canvas cover, three pieces canvas, high collar. Capacity, 42 ounces. Weight, 17 ounces. (See cut U.)

V. —Regulation Aluminum Canteen, Germany Army Pattern, 1899. Manufactured by Carl Berg, Eveking, Westphalia, Ger-



The Lanz Sabretache, or Dispatch Holder, for the use of Mounted Officers U.S.A.

Scale: ⅓

many. Covered with grayish felt cloth, single thickness, provided with black leather loops and straps. Capacity, 25 ounces. Weight, 7 and ¼ ounces. (See cut V.)

W.—Karlsruhe, Baden, Germany, Naked Aluminum Flask. Weight, 9 ounces. Capacity, 44 fluid ounces. Single piece metal, with steel rings attached to an aluminum lug (each two pieces), riveted to the flask by means of two rivets. (See cut W.)

X. —Karlsruhe, Baden, Germany, Naked Aluminum, single piece flask. Weight, 9 ounces. Capacity, 44 fluid ounces. Provided with stirrup shaped loops clamped to the flask by means of four rivets. (See cut X.)

Type of Wooden Canteen, used in the United States Army, pattern of 1812, and during our second war with England. (From a tracing furnished by the Quartermaster General, U. S. Army). One view.

Tracing furnished by the Quartermaster General U. S. Army, of the type of tin flask canteen covered with cloth, used in the United States Army, 1848-1861.

TEST No. 30.

Hour.	Outside Temperature.	TEMPERATURE OF WATER IN CANTEENS. Each Canteen Being Filled to its Capacity.								
		A	B	C	D	E	F	G	H	I
10 a. m...	*7	54	54	54	54	54	54	54	54	54
11 " ...	8	36	48	32	32	32	44	44	52	46
12 m.....	8	32	36	*	*	*	34	36	44	41
1 p. m...	8	*	32				32	32	38	34
2 " ...			*				*	*	36	32
3 " ...	8								33	32

*Leaky.

TEST No. 31.

Hour.	Outside Temp.	Temperature of Water in Canteens. Each canteen being filled to its capacity.										
		A	B	C	D	E	F	G	H	I	K	L
9:00 a.m.	+10	52	52	52	52	52	52	52	52	52	52	52
10:00 " ..	10	32	38	32	32	32	42	36	42	42	36	40
10:30 a. m.	10	*	34	*	*	*	36	36	38	42	36	36
11:00 "	10		32				36	36	38	40	32	32
11:30 "	12		32				33	32	37	35	32	32
12:00 m...	12		32				32	32	34	33	32	32
12:30 p. m.	12		32				32	32	32	32	32	32

*Leaky.

TEST No. 32.

Hour.	Outside Temp.	Temperature of Water in Canteens. Quantity of water (36 ozs.) same in each canteen. A	B	C	D	E	F	G	H	I	K	L
1:30 p. m	+14		56	56			56	56	56	56	56	56
2:30 "	14		32	32			48	46	46	48	38	34
3:00 "	14		32	32			44	46	44	44	42	34
3:30 "	14		32	32			40	44	40	38	39	32
4:00 "	14		32	32			36	36	38	36	36	32
4:30 "	14		32	32			34	36	32	34	32	32
5:00 "	14		32	32			32	34	32	32	32	32

TEST No. 33.

Hour.	Outside Temp.	Temperature of Water in Canteens. Quantity of water (36 ozs.) in each canteen. A	B	C	D	E	F	G	H	I	K	L
8:45 a. m	+20		112	112			*112	112	112	112	112	112
9:45 "	20		82	40			* 90	90	86	86	88	66
10:45 "	20		60	32			* 68	76	72	70	68	44
11:45 "	20		48				* 56	68	60	58	56	34
12:45 p. m	22		38				* 46	58	52	50	48	32
1:45 "	22		34				* 40	50	46	44	42	
2:45 "	23		32				* 34	46	42	40	38	
3:45 "	23						* 32	40	38	36	34	

*Leaky.

TEST No. 34.

Hour.	Outside Temp.	Temperature of Water in Canteens. Quantity of water same in each canteen. A	B	C	D	E	F	G	H	I	K	L
8:45 a. m	+32		110	110			110	110	110	110	110	110
9:45 "	32		92	60			92	96	90	94	94	78
10:45 "	32		74	42			74	84	78	80	80	58
11:45 "	33		64	36			64	74	70	70	68	50
12:45 p. m	34		56	34			56	66	62	62	60	44
1:45 "	34		48	34			50	60	58	56	54	40
2:45 "	34		44	34			46	56	54	52	50	38
3:45 "	34		42	34			44	52	50	48	48	36

TEST No. 35.

Hour.	Outside Temp.	Temperature of Water in Canteens. Quantity of water (36 ozs.) same in each canteen. A	B	C	D	E	F	G	H	I	K	L
8:40 a. m	+32		116	116			116	116	116	116	116	116
9:40 "	33		90	66			98	100	94	98	96	82
10:40 "	36		76	50			82	88	84	86	82	66
11:40 "	38		64	42			72	79	74	75	72	54
12:40 p. m	40		58	40			64	72	68	67	64	48
1:40 "	41		52	41			58	66	62	62	59	46
2:40 "	41		50	41			54	62	58	56	56	44
3:40 "	40		48	40			52	58	54	52	52	42
4:40 "	38		44	38			48	54	52	50	49	42

TEST No. 36.

Hour.	Outside Temp.	Temperature of Water in Canteens. Quantity of water (36 ozs.) same in each canteen.										
		A	B	C	D	E	F	G	H	I	K	L
8:30 a. m	+25	116	116	116			116	116	116	116	116	116
9:30 "	26	72	86	56			94	96	92	92	90	76
10:30 "	28	54	70	40			80	84	80	80	76	58
11:30 "	30	44	60	34			68	74	70	70	68	46
12:30 p. m	32	38	52	32			60	64	62	62	68	42
1:30 "	32	36	46	32			54	60	56	54	54	39
2:30 "	32	35	40	32			48	54	52	50	48	36
3:30 "	32	34	40	32			44	50	48	46	44	36
4:30 "	32	32	36	32			42	48	46	44	42	34

TEST No. 37.

Hour.	Outside Temp.	Temperature of Water in Canteens and Flasks. Each Canteen and Flask filled to its capacity.										
		A	B	C	D	E	F	G	H	I	K	L
8:35 a. m	+22	116	116	116	116	116	116	116	116	116	116	116
9:35 "	24	88	94	58	56	60	*96	94	103	99	91	86
10:35 "	28	66	76	40	38	40	84	82	92	84	78	68
11:35 "	36	56	66	36	36	38	72	72	86	74	70	58
12:35 p. m	38	51	58	38	38	38	66	66	78	66	62	52
1:35 "	38	48	52	38	38	38	60	62	74	62	53	48
2:35 "	40	44	50	38	40	40	58	56	72	58	56	46
3:35 "	40	44	48	38	40	40	54	54	66	56	52	44
4:35 "	38	42	42	38	40	40	52	52	64	52	50	42

*Leaky.

TEST No. 38.

Hour.	Outside Temp.	Temperature of Water in Canteens and Flasks. Each Canteen and Flask filled to its capacity.										
		A	B	C	D	E	F	G	H	I	K	L
8:35 a. m	+32	100	100	100	100	100	100	100	100	100	100	100
9:35 "	32	78	88	52	55	52	*88	86	96	88	86	78
10:35 "	34	64	68	40	38	40	76	76	86	76	72	62
11:35 "	36	52	60	36	36	37	66	66	82	66	62	54
12:35 p. m	36	48	54	36	36	36	62	62	74	62	58	48
1:35 "	36	44	50	36	36	36	54	56	70	56	54	44
2:35 "	38	42	46	38	38	38	52	54	66	52	50	42
3:35 "	38	42	44	38	38	38	50	50	62	48	48	42
4:35 "	36	40	42	38	38	38	48	48	60	46	46	40

*Leaky.

TEST No. 39.

Hour.	Outside Temp.	Temperature of Water in Canteens and Flasks. Each Canteen and Flask having 36 ozs. hot water.										
		A	B	C	D	E	F	G	H	I	K	L
8:15 a. m	+38	94	94	94			*94	94	94	94	94	94
9:15 "	38	74	78	60			86	88	82	84	84	72
10:15 "	40	64	68	48			78	78	74	76	74	60
11:15 "	40	56	60	44			70	70	68	68	66	52
12:15 p. m	42	52	54	42			64	62	66	64	60	50
1:15 "	42	48	52	42			60	60	60	58	58	46
2:15 "	40	46	48	42			56	58	56	54	54	44
3:15 "	40	44	48	42			54	56	52	52	52	44
4:15 "	40	44	46	40			53	54	52	50	50	42

*Leaky.

TEST No. 40.

Hour	Outside Temp.	Temperature of Water in Canteens. Quantity of water (36 ozs.) same in each canteen.										
		A	B	C	D	E	F	G	H	I	K	L
8:45 a. m	+12	96	96	96			*96	96	96	96	96	96
9:45 "	12	68	74	42			76	80	78	80	76	62
10:45 "	14	48	56	32			66	66	64	64	62	44
11:45 "	14	38	46	32			52	58	54	54	52	32
12:45 p. m	14	32	32	32			44	50	48	46	44	32
1:45 "	14	32	32	32			38	44	42	40	40	32
2:45 "	14	32	32	32			32	38	36	36	34	32
3:45 "	13	32	32	32			32	34	32	32	32	32

*Leaky.

TEST No. 41.

Hour.	Outside Temp.	Temperature of Water in Canteens. Quantity of water (36 ozs) same in each canteen.										
		A	B	C	D	E	F	G	H	I	K	L
8:30 a. m	+10	98	98	98			98	98	98	98	98	98
9:30 "	12	68	74	46			*82	84	84	78	80	66
10:30 "	14	52	58	32			64	70	68	66	66	46
11:30 "	18	40	46	32			54	62	60	56	54	36
12:30 p.m	20	34	42	32			46	54	52	48	48	32
1:30 "	26	32	38	32			42	48	48	42	44	32
2:30 "	26	32	36	32			40	44	44	40	40	32
3:30 "	28	32	34	32			36	42	42	38	38	32
4:30 "	26	32	32	32			36	42	40	36	36	32

*Leaky.

TEST No. 42.

Hour.	Out-side Tem.	Temperature of Water in Canteens. Quantity of water 36 ozs., except in flasks "N" and "O," in the main filled to their capacity.													
		A	B	C	D	E	F	G	H	I	K	L	M	N	O
8:15 a. m.	+24	94	94	94			*94	94	94	94	94	94	94	94	94
9:15 "	24	68	74	48			78	82	76	78	76	64	44	44	36
10:15 "	22	52	60	34			66	70	66	66	68	48	32	32	32
11:15 "	22	40	50	32			56	62	56	56	58	40	32	32	32
12:15 p. m.	22	36	42	32			48	54	50	50	50	34	32	32	32
1:15 "	22	32	40	32			42	50	44	44	44	32	32	32	†
2:15 "	22	32	32	32			38	44	40	40	40	32	32	32	
3:15 "	22	32	32	32			34	42	38	56	36	32	32	32	
4:15 "	26	32	32	32			32	36	38	32	32	32	32	32	

*Leaky. †Frozen.

TEST No. 43.

Hour.	Out side T.	Temperature of Water in Canteens. Quantity in each (36 ozs) the same, except in Flasks "N," "O" and "P," which were filled to their capacity.														
		A	B	C	D	E	F	G	H	I	K	L	M	N	O	P
a, m.																
8:15	+ 4	94	94	94			†94	94	94	94	94	94	94	94	94	94
9:15	6	64	70	42			76	76	72	76	74	60	42	42	32	62
10:15	8	46	52	32			60	64	62	62	60	42	32	32	32	44
11:15	8	34	42	32			48	54	50	50	50	32	32	32	*	34
p. m.																
12:15	8	32	34	32			40	48	44	44	42	32	32	32		32
1:15	8	32	32	32			32	40	36	36	36	32	32	*		32
2:15	10	32	32	32			32	34	32	32	32	32	32			32
3,15	12	32	32	32			32	32	32	32	32	32	32			*
4:15	12	32	32	32			32	32	32	32	32	32	32			

*Leaky. †Frozen.

TEST No. 44.

Hour.	Out side T.	Temperature of Water in Canteens. Conditions same as in Test No 43, except Flasks "D", "N". "O"and "P", which were filled.														
		A	B	C	D	E	F	G	H	I	K	L	M	N	O	P
a. m.																
8:15	†14	106	106	106	106	106	106	106	106	106	106	106	106	106	106	106
9:15	18	72	78	50	50	54	†80	86	84	86	84	68	48	46	38	66
10:25	22	54	62	34	32		66	72	72	72	70	50	34	32	32	50
11:15	26	44	52	32	32	32	56	64	62	62	62	42	32	32	32	42
p. m.																
12:15	30	40	36	32	32	32	50	58	56	56	54	38	32	32	32	38
1:15	32	36	42	32	32	32	46	52	52	52	50	36	32	32	33	36
2:15	34	36	40	32	32	32	42	50	48	48	46	36	32	32	32	36
3:15	34	36	38	32	32	34	40	48	48	48	46	36	32	32	32	36
4:15	34	36	38	32	34	34	38	46	44	44	42	36	33	33	32	36

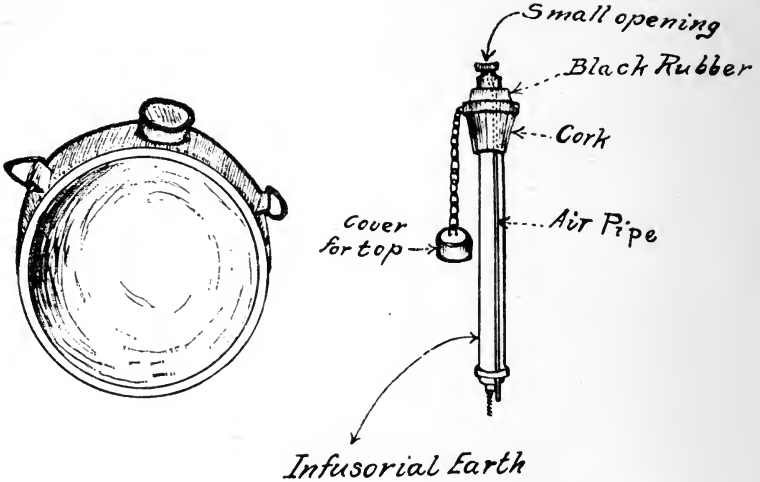
†Frozen.

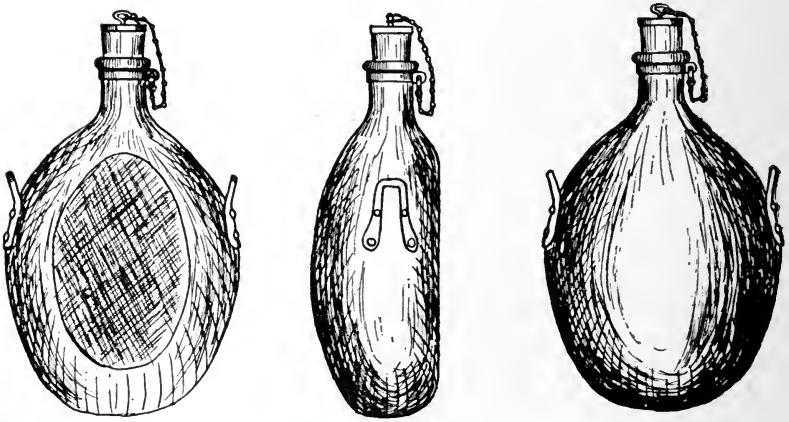
TEST No. 45.

Hour.	Out side T.	Temperature of Water in Canteens. Conditions same as in Test No. 44.														
		A	B	C	D	E	F	G	H	I	K	L	M	N	O	P
a. m.																
8:25	–10	100	100	100	100	100	100	100	100	100		100	100	100	100	100
9:25	8	68	72	36	40	32	†74	80	80	78		56	36	36	32	58
10.25	6	42	52	32	32	*	56	66	64	62		36	32	32	*	40
11:25	5	32	38	32	*		42	54	52	48		32	32	*		32
p. m.																
12:25	4	32	32	*			32	44	42	38		32	32			32
1:25	4	32	32				32	32	32	32		32	32			32
2:25	2	32	32				32	32	32	32		32	*			*
3:25	2	32	32				32	32	32	32		32				
4:25	2	32	32				32	32	32	32		32				

*Leaky. †Frozen.

CCC





X

Karlsruhe, Baden, Germany, naked Aluminum single piece flask, weight, 9 oz. Capacity 44 fluid oz. with stirrup shaped loops clamped to the flask by means of four rivets. Submitted for test by the Lanz manufacturing Co, 183 Lake st Chicago Ill.

Scale: ½

TEST No. 46.

Hour.	Outside Temp.	Temperature of Water in Canteen. Quantity (45 ozs.) being the same, except in "A," "D," "F," "G," "N," "O" and "P," which were filled.															
		A	B	C	D	E	F	G	H	I	K	L	M	N	O	P	Q
8:10 a. m.....	−10	102	102	102	102	102	102	102	102	102	102		102	102	102	102	102
9:10 "	10	68	76	38	38	32	78	82	80	80	76		38	34	32	32	78
10:10 "	8	44	58	32	32	†	60	66	66	60	62		32	32	32	32	66
11:10 "	6	32	42	32	†		46	52	52	52	46		†	†	†	32	52
12:10 p. m	4	32	32	†			34	42	44	42	36					32	42
1:10 "	2	32	32				32	34	38	36	32					32	36
2:10 "	0	†	†			‡	32	32	32	32	32					†	32
3:10 "	− 2			‡			32	32	32	32	†						32
4:10 "	2						32	32	32	32							32

†Frozen. ‡Bursted.

During Test No. 46 the Dubuque enameled canteen froze after two hours exposure and burst open at the seams along the edges, during the next hour. It had forty-five (45) fluid ounces of water, temperature 102 deg., F., placed in it at 8:10 a. m. The variations of air temperature were, (observations made hourly), as follows: −10 deg.; −8 deg.; −6 deg. The temperature of the contents of the canteen fell from 102 deg. to 38 deg. after one hour's exposure; at the expiration of the second hour the fluid dropped to 32 deg. During this test, the enamel splintered off around the edges; little blisters of enamel, like small volcanoes, bubbled up, and patches of the enamel blew off, exposing the metallic base. The cause was simple. The Dubuque Stamping and Enamel Co. canteen is a combination of mineral and metal; the metal contracted; result, disintegration. (See illustration ———).

TEST No. 47.

Hour.	Outside. Temp.	Temperature of Water in Canteens. Quantity (45 fluid ozs.) being the same in each, except in "D," "F," "G," "N" and "O," which were filled.															
		A	B	C	D	E	F	G	H	I	K	L	M	N	O	P	Q
8:15 a. m.....	+14	80	80	*80	80	80	80	80	80	80	80	80	80	80	80		80
9:15 "	16	60	63	32	38	38	68	74	68	74	70	64	34	32	32		72
10:15 "	20	48	58	32	32	32	56	64	60	66	62	52	32	32	32		64
11:15 "	24	42	48	32	32	32	48	38	42	58	54	42	32	32	32		58
12:15 p.m.....	26	38	46	32	32	32	42	52	48	52	48	40	32	32	32		52
1:15 "	26	34	42	32	†	32	40	48	44	48	44	36	32	32	32		48
2:15 "	28	32	38	32		32	38	46	42	44	42	34	32	32	32		46
3:15 "	28	32	36	32		32	36	42	38	42	40	32	32	32	32		44
4:15 "	28	32	34	32		32	34	40	38	40	38	32	32	32	32		40

*Leaky. †Frozen.

TEST No. 48.

Hour.	Outside Temp.	Temperature of Water in Canteens. Quantity of water (45 fluid ozs.), same in each canteen, except in "A," "D" "F," "G," "N," "O" and "P," which were filled.															
		A	B	C	D	E	F	G	H	I	K	L	M	N	O	P	Q
8:10 a. m.....	+14	80	80	†80	80	80	80	80	80	80	80	80	80	80	80	80	80
9:10 "	14	60	66	32	38	44	*	70	68	72	70	56	36	*	*	*	70
10:10 "	14	46	52	32	32	32	68	60	58	62	58	42	32	32	32	46	60
11:10 "	14	36	42	32	†	32	56	52	50	52	50	34	32	32	32	34	52
12:10 p.m.....	14	32	36	32		†	48	44	44	46	42	32	32	32	†	32	46
1:10 "	16	32	32	32			42	36	40	40	38	32	33	32		32	38
2:10 "	16	32	32	32			32	34	36	38	24	32	32	32		32	38
3:10 "	18	32	32	32			32	32	34	34	32	32	32	32		32	34
4:10 "	18	32	32	†			†	32	32	32	32	32	†	†		32	32

*Leaky. †Frozen.

TEST No. 49.

Hour.	Out-side Temp.	Temperature of Water in Canteens. Conditions same as in Test No. 48. Snow fell during about two hours of the time occupied in making the test.															
		A	B	C	D	E	F	G	H	I	K	L	M	N	O	P	Q
8:00 a. m.....	+ 8	130	130	130	130	130	130	130	130	130	130	130	130	130	130	130	130
9:00 "	8	86	94	*	56	*	*	100	96	104	98	80	48	*	*	*	102
10:00 "	10	62	72	50	32	60	104	84	82	86	80	56	32	32	32	50	84
11:00 "	12	46	58	32	32	34	84	68	68	72	66	40	32	32	32	32	72
12:00 m.....	14	36	48	32	32	32	68	60	58	62	56	34	32	32	32	32	64
1:00 p.m.....	16	32	40	32	†	32	58	50	54	54	50	32	32	†	†	32	56
2:00 "	16	32	36	32		32	50	46	46	46	42	32	32			32	48
3:00 "	18	32	32	32		32	42	40	40	42	38	32				†	44
4:00 "	18	32	32	32		32	38	36	36	38	26	32					40

*Leaky. †Frozen.

TEST No. 50.

Hour.	Out-side Temp.	Temperature of Water in Canteens. Every canteen and flask filled to its capacity.															
		A	B	C	D	E	F	G	H	I	K	L	M	N	O	P	Q
8:00 a. m.....	+ 4	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
9:00 "	6	40	42	*32	†	*32	*42	42	48	42	42	38	32	*32	32	34	42
10:00 "	8	32	34	32		32	36	38	44	40	34	32	32	32	†	32	38
11:00 "	12	32	32	32		32	32	32	40	34	32	32	32	32		32	34
12:00 m.....	16	32	32	32		†	32	32	36	32	32	32	†	32		32	32
1:00 p.m.....	18	32	32	32			32	32	32	32	32	32		32		32	32
2:00 "	22	32	32	32			32	32	32	32	32	32		32		32	32
3:00 "	22	†	†	†	‡		32	32	32	32	†	32		32		32	32
4:00 "	24				§		32	32	32	32				32		32	32

*Leaky †Frozen. ‡Bursted. §At starting had a capacity of 25 ozs.; at the finish its capacity was 30 ozs.

TEST No. 51.

Hour.	Out. side Temp.	Temperature of Water in Canteens. Every canteen and flask being filled to its capacity.																		
		A	B	C	D	E	F	G	H	I	K	L	M	N	O	P	Q	R	S	T
a.m.																				
8:00	+16	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	59
9:00	14	36	40	32	‡	32	40	42	50	44	42	36	32	32	‡	32	42	42	42	40
10:00	10	32	32	32		32	34	38	48	38	38	32	32	32		32	36	36	36	34
11:00	10	32	32	32		†	32	32	44	32	32	32	†	32		†	34	32	34	32
12 m.	10	†	32	32			*32	32	36	32	32	†		32			32	32	32	32
p. m.																				
1:00	8		32	32			32	32	34	32	32			†		*	32	32	32	32
2:00	8		†	†			32	32	32	32	32						32	†	32	32
3:00	10			*		‡	32	32	32	32	†			*			†		†	†
4:00							32	†	32	†			*							

*Leaky. †Frozen. ‡Bursted.

TEST No. 52.

Hour.	Out-side Temp.	Temperature of Water in Canteens. Every canteen and flask filled to its capacity.																		
		A	B	C	D	E	F	G	H	I	K	L	M	N	O	P	Q	R	S	T
a.m.																				
8:00	+ 2	178	178	178	‡	178	178	178	178	178	178	178	‡	‡	‡	178	178	178	178	178
9:00	2	*46	108	*46		60	*98	138	138	124	130	106				*40	134	134	136	132
10:00	4	32	74	32		32	80	110	110	94	102	76				32	108	108	110	102
11:00	8	32	56	32		32	62	90	98	78	80	54				†	90	88	90	86
12 m.	10	32	42	32		†	48	76	86	62	66	40					76	74	76	70
p. m.																				
1:00	12	32	36	†			38	66	74	52	54	34					64	62	64	60
2:00	12	32	32				32	56	66	44	44	32					56	54	56	50
3:00	14	32	32				32	46	58	38	38	32					48	46	48	44
4:00	14	32	32	‡			32	38	54	34	34	32					42	40	42	40

*Leaky. †Frozen. ‡Bursted.

TEST No. 53.

Hour.	Out-side Temp.	Temperature of Water in Canteens. Conditions same as in Test No. 52.																		
		A	B	C	D	E	F	G	H	I	K	L	M	N	O	P	Q	R	S	T
a.m.																				
8:00	+18	168	168	168	168	168	168	168	168	168	168	168	168	168	168	168	168	168	168	168
9:00	20	108	126	‡	‡	86	112	138	140	138	138	124	‡	‡	‡	‡	140	140	138	140
10:00	22	78	106			56	90	120	126	118	118	100					122	124	118	116
11:00	24	58	86			38	72	102	112	102	98	80					106	104	102	98
12 m.	24	48	70			34	60	90	100	88	86	68					94	92	90	86
p. m.																				
1:00	28	42	62			32	52	78	92	78	76	58					84	80	78	74
2:00	26	36	52			32	44	68	84	68	64	50					74	72	70	66
3:00	24	34	46			32	40	62	76	66	58	44					66	64	62	60
4:00	24	32	44			32	38	56	72	56	52	42					62	60	58	54

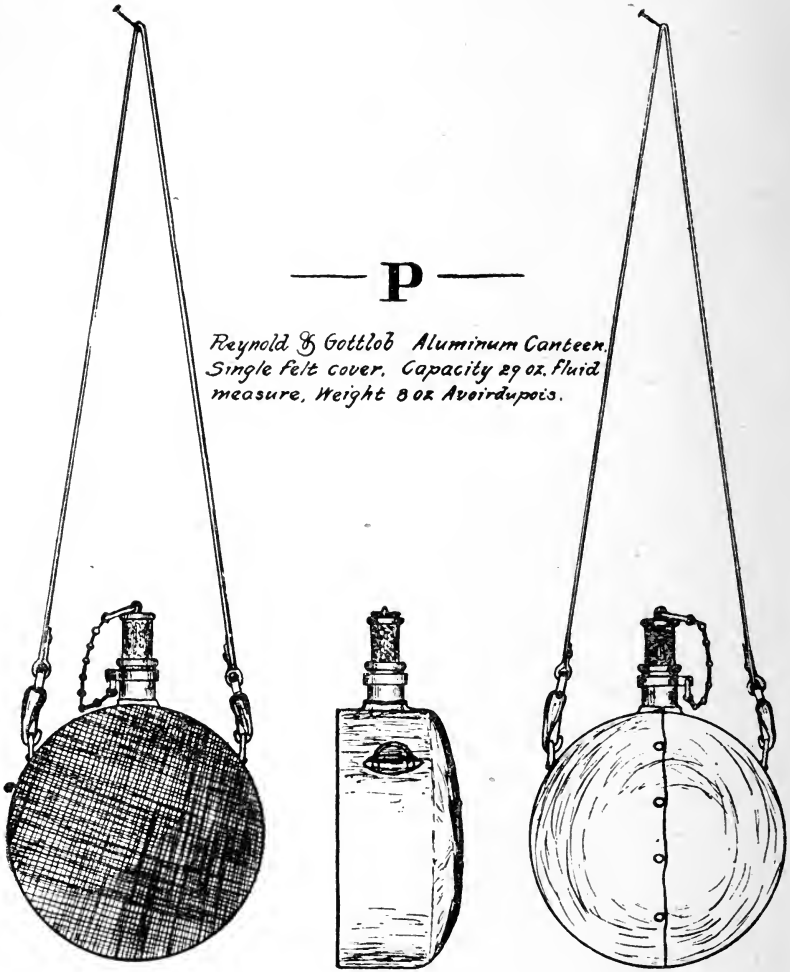
*Leaky. †Frozen. ‡Bursted.

TEST No. 54.

Hour	Out-side Temp.	Temperature of Water in Canteens. Same canteens, conditions, etc., as in Test No. 53, except that a snow storm prevailed most of the time covered by the test.																		
		A	B	C	D	E	F	G	H	I	K	L	M	N	O	P	Q	R	S	T
a.m.																				
8:00	+22	170	170			170	170	170	170	170	170	170					170	170	170	170
9:00	24	116	132			106	146	140	150	138	136	128					146	144	146	142
10:00	26	82	104			70	114	120	132	116	114	104					124	126	122	118
11:00	26	66	88			52	94	102	120	102	98	88					110	110	106	104
m.																				
12:00	28	52	74			42	78	90	110	88	86	72					98	96	94	90
p. m.																				
1:00	30	46	66			38	68	80	102	80	78	64					88	86	84	80
2:00	30	40	58			36	58	72	92	70	68	56					80	78	74	70
3:00	30	38	52			32	50	64	84	64	62	50					72	70	66	64
4:00	28	36	48			32	44	60	80	58	56	46					66	64	60	58

— P —

Reynold & Gottlob Aluminum Canteen. Single felt cover. Capacity 29 oz. Fluid measure. Weight 8 oz Avoirdupois.



Scale: ⅓

TEST No. 55.

Hour.	Out-side Temp.	Temperature of Water in Canteens. Each canteen filled.																	
		A	B	C	D	E	F	G	H	I	K	L	M	N	O	P	Q	R	S	T
a.m.																			
8.00	†12	52	52	52		52	52	52		52	52	52					52	52	52	52
9.00	8	†	38			†	*42	42		42	42	38					42	42	42	42
10.00	8		32				36	36		36	34	32					36	36	36	34
11.00	8		32				32	32		32	32	32					32	32	32	32
m.																				
12.00	10		32				32	32		32	32	†					32	32	32	32
p. m.																				
1.00	14		32				32	32		32	32						32	32	32	32
2.00	16		32				32	32		32	†						32	32	32	32
3.00	18	‡	32				32	32		32							32	32	32	32
4.00	22		†				32	†		†							†	32	†	32

*Leaky. †Frozen. ‡Bursted.

TEST No. 56.

Hour.	Out. side Temp.	Temperature of Water in Canteens. Each canteen filled.																	
		A	B	C	D	E	F	G	H	I	K	L	M	N	O	P	Q	R	S	T
a.m.																			
7 50	†24	50	50			50	50	50		50	50	50					50	50	50	50
8.50	26	40	42			36	*46	46		46	46	42					46	46	46	44
9.50	26	34	40			32	42	44		42	42	38					42	44	42	42
10.50	30	34	36			32	40	42		40	40	36					40	42	42	40
11.50	32	34	34			32	38	40		38	40	34					40	40	40	38
p. m.																				
12.50	34	34	34			32	38	40		38	40	34					38	40	40	38
1.50	36	34	34			34	38	40		36	38	34					38	40	40	38
2.50	38	36	34			36	36	38		36	38	36					38	38	38	38
3.50	38	36	34			36	38	38		38	38	36					38	38	38	38

*Leaky.

TEST No. 57.

Hour.	Out-side Temp.	Temperature of Water in Canteens. It rained during part of the time. All canteens filled.																	
		A	B	C	D	E	F	G	H	I	K	L	M	N	O	P	Q	R	S	T
a.m.																			
7.45	†32	52	52			52	52	52		52		52					52	52	52	52
8.45	34	46	44			40	*46	50		52		46					46	48	46	46
9.45	34	40	42			36	42	46		50		42					44	46	44	44
10.45	36	40	40			36	42	44		46		40					44	44	44	42
11.45	38	40	38			38	42	44		46		40					42	44	42	42
p.m.																				
12.45	42	40	40			40	42	44		46		40					42	44	42	42
1.45	42	42	40			40	42	44		44		42					42	44	42	42
2.45	40	40	40			40	42	42		44		42					42	44	42	42
3.45	40	40	38			40	42	42		42		40					42	42	42	42

*Leaky.

TEST No. 58.

Hour	Out-side Tem.	Temperature of Water in Canteens. Every canteen was filled to its capacity. A	B	C	D	E	F	G	H	I	K	L	M	N	O	P	Q	R	S	T	U
a.m.																					
7.45	+12	54	54			54	*54	54		54		54					54	54	54	54	54
8.45	12	34	38			32	42	44		46		36					42	42	42	42	42
9.45	14	32	32			†	38	38		40		32					36	36	36	36	38
10.45	14	32	32				32	32		34		32					32	32	32	32	34
11.45	16	32	32				32	32		32		32					32	32	32	32	32
p.m.																					
12.45	16	32	32				32	32		32		†					32	32	32	32	32
1.45	16	32	†				32	32		32							32	32	32	32	32
2.45	18	†					32	32		32							32	32	32	32	32
3.45	18						32	32		†							†	32	32	32	32

*Leaky. †Frozen.

TEST No. 59.

Hour	Out-side Tem.	Temperature of Water in Canteens. All conditions identical with Test No. 58. A	B	C	D	E	F	G	H	I	K	L	M	N	O	P	Q	R	S	T	U
a.m.																					
7.50	-4	52	52			52	52	52		52		52					52	52	52	52	52
8.50	4	32	32			32	*36	38		42		32					38	36	36	36	36
9.50	4	†	†			†	32	32		32		32					32	32	32	32	32
10.50	2						32	32		32		†					32	32	32	32	32
11.50	0						32	32		32							32	32	32	32	32
p.m.																					
12.50	0																†	32	32	32	32
1.50	+2						32	32		32								32	32	32	32
2.50	2						32	32		32								32	32	32	32
3.50	4		‡				32	32		32								32	32	32	32

*Leaky. †Frozen. ‡Bursted.

TEST No. 60.

Hour.	Out-side Temp.	Temperature of Water in Canteens. All the canteens were filled. Snow fell during a portion of the time covered by test. A	B	C	D	E	F	G	H	I	K	L	M	N	O	P	Q	R	S	T	U
8.00 a.m.	+ 2	170				170	170	170		170		170					170	170	170	170	170
9.00 "	2	108				104	138	136		136		128					138	142	138	136	142
10.00 "	10	70				64	108	112		114		94					118	118	114	114	116
11.00 "	14	52				42	86	96		94		74					100	100	98	94	100
12.00 m.	18	40				32	72	82		80		60					86	86	84	80	86
1.00 p. m.	20	34				32	60	70		70		50					74	74	76	70	74
2.00 "	22	32				32	48	60		60		42					64	64	62	60	64
3.00 "	22	32				32	42	54		52		36					56	56	56	52	56
4.00 "	20	32				32	38	46		46		32					50	50	50	46	50

Memorandum made of the fact that Canteen "L" held 60 fluid ozs. when capacity was measured prior to Test No. 37. Owing to dilation due to freezing, its capacity was 64 fluid ozs. when Test No. 60 was made.

TEST No. 61.

Hour.	Outside Temp.	Temperature of Water in Canteens. All the canteens were filled.																		
		A	B	C	D	E	F	G	H	I	K	L	M	N	O	P	Q	R	S	T	U
7.50 a.m.	0	172				172	172	172		172		172					172	172	172	172	172
8.50 "	+ 2	90				66	136	130		132		112					138	136	134	134	136
9.50 "	4	52				32	102	108		104		78					112	106	108	106	110
10.50 "	8	34				32	80	86		84		56					92	86	86	86	88
11.50 "	12	32				32	60	70		66		40					76	70	72	68	70
12.50 p. m.	14	32				32	48	60		56		34					64	58	62	58	60
1.50 "	18	32				†	38	50		48		32					54	50	52	50	50
2.50 "	20	32					32	44		40		32					46	42	44	42	44
3.50 "	20	32					32	38		36		32					42	38	40	38	38

†Frozen.

TEST No. 62.

Hour.	Outside Temp.	Temperature of Water in Canteens. All the canteens were filled.																		
		A	B	C	D	E	F	G	H	I	K	L	M	N	O	P	Q	R	S	T	U
8.00 a.m.	+20	168				168	168	168		168		168					168	168	168	168	168
9.00 "	20	108				90	136	138		136		124					140	138	140	140	138
10.00 "	20	74				54	108	116		112		94					118	118	118	114	118
11.00 "	20	52				36	82	96		94		72					106	98	98	96	98
12.00 m.	20	40				32	64	80		80		56					86	84	82	80	84
1.00 p.m.	20	32				32	50	68		68		48					76	72	70	70	74
2.00 "	22	32				32	42	60		58		40					66	62	62	60	64
3.00 "	22	32				32	32	46		50		34					56	54	54	52	56
4.00 "	20	32				32	32	46		46		32					50	48	48	48	60

TEST No. 63.

Hour.	Out side T.	Temperature of Water in Canteens. All the canteens were filled.														
		A	B	C	E	G	H	I	L	Q	R	S	T	U	V	W	X
a. m.																	
8:00	+14	184			184	184		184	184	184	184	184	184	184			
9:00	16	100			90	144		144	130	150	144	144	140	148			
10.00	26	70			54	122		122	100	126	122	122	120	124			
11:00	28	54			40	102		102	80	106	106	104	100	106			
12 m.	30	44			34	88		86	66	94	88	88	86	92			
p. m																	
1:00	32	40			32	78		76	56	82	80	80	76	82			
2:00	34	38			32	68		68	50	72	70	60	68	72			
3:00	36	36			36	58		56	46	66	64	64	62	66			
4:00	36	36			36	58		56	44	62	60	60	56	60			

TEST No. 64.

Hour.	Out side T.	Temperature of Water in Canteens. Each canteen was filled. A	B	C	E	G	H	I	L	Q	R	S	T	U	V	W	X
a. m.																	
7.45	+26	48			48	48		48	48	48	48	48	48	48			
8.45	30	40			40	44		44	44	44	46	44	44	46			
9.45	34	38			36	42		42	40	42	42	42	42	44			
10.45	38	38			38	42		42	40	42	42	42	42	42			
11.45	38	38			38	42		40	40	42	42	42	42	42			
p. m.																	
12.45	36	36			38	40		40	38	40	40	40	40	42			
1.45	34	36			36	40		38	38	40	40	40	40	40			
2.45	34	34			34	38		38	36	40	38	38	38	38			
3.45	32	32			34	36		36	34	38	36	38	36	38			

TEST No. 65.

Hour.	Out-side Temp.	Temperature of Water in Canteen. Each canteen was full. A	B	C	E	G	H	I	L	Q	R	S	T	U	V	W	X
8.15 a. m.	+38	162			162	162	162	162	162	162	162	162	162	162	162	162	162
9.15 "	38	102			82	136	138	132	118	138	134	134	132	132	100	76	74
10.15 "	40	76			56	114	124	114	92	118	112	114	112	112	74	52	50
11.15 "	40	62			46	100	112	100	78	104	98	100	98	98	64	44	44
12.15 p. m.	42	56			44	90	102	88	68	92	86	90	86	88	56	44	42
1.15 "	42	50			44	80	94	76	60	82	78	80	76	78	52	44	42
2.15 "	42	48			44	70	88	70	54	76	70	72	70	72	50	42	42
3.15 "	40	44			42	66	84	64	50	68	64	66	64	64	46	*40	*40
4.15 "	38	42			40	60	76	60	46	62	60	60	60	60	42	40	40

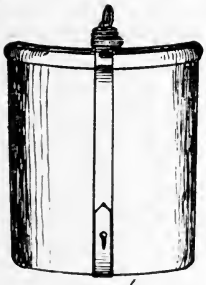
*Leaky.—Leakage in "W" and "X" occurred at points where lugs were riveted to the flask.

TEST No. 66.

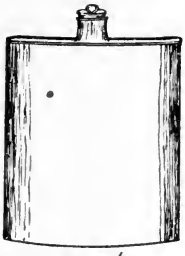
Each canteen was full. A severe snowstorm continuously prevailed during this test. All canteens were suspended from a trestle and exposed to a high wind which kept them in motion.

Hour.	Outside Temperature.	Temperature of Water in Canteens. A	B	C	E	G	H	I	L	Q	R	S	T	U	V	W	X
11.00 a. m.	+21	50			50	50	50	50	50	50	50	50	50	50	50	50	50
12.00 m.	21	38			36	50	50	50	48	46	44	44	46	46	38	36	34
2.00 p. m.	21	32			36	40	44	40	36	40	38	38	38	38	32	†	32
3.00 "	21	32			32	36	42	36	34	36	34	34	34	34	32		32
4.00 "	21	32			32	34	40	32	32	34	34	34	34	34	32		32

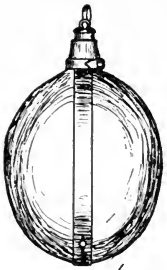
†Frozen.



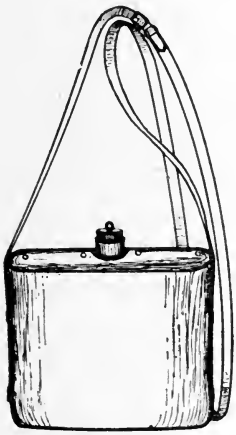
No 101/b
Indian Army Bottle with cover and carbine hook.



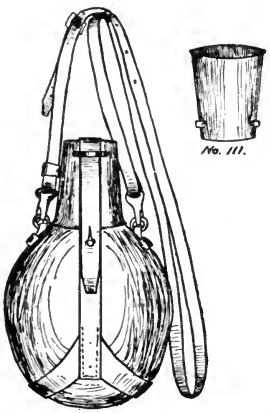
No. 101/a
Indian Army Bottle without cover.



No. 116/b
Tourist Flask with felt cover and swivel.



No. 102/c
Indian Army Bottle with cover and hanging strap.



No. 111.

No. 110.
Flask for Soldiers

Aluminum Flasks from the Lanz Mfg. Co., Chicago. Made by Wilhelm Berg, Ludenscheid, Germany.

TEST No. 67.

Each canteen was full. A snowstorm prevailed during first half of test. All of the canteens were suspended from a trestle so that free circulation obtained.

Hour.	Outside Temperature.	Temperature of Water in Canteens.															
		A	E	G	H	I	L	Q	R	S	T	U	V	W	X	B	A-I
8.30 a. m.	+16	50	50	50	50	50	50	50	50	50	50	50	50	20	50		
9.30 "	19	38	†	42	40	40	36	40	40	40	40	40	36	†	32		
10.30 "	20	32		38	40	38	32	36	36	38	40	38	32		32		
11.30 "	20	32		34	38	†	32	36	36	36	38	36	32		†		
12.30 p. m.	20	†		32	37		32	32	32	35	32	32	32				
1.30 "	18			32	36		32	32	32	34	32	32	32				
2.30 "	18			32	34		32	32	32	32	32	32	32				
3.30 "	19			32	32		32	32	32	32	32	32	†				
4.30 "	19			32	†		32	32	32	†	†	32					

†Frozen.

TEST No. 68.

Each filled canteen was plunged into a snow bank, and kept buried in the snow through the period of the test—eight and one-half hours.

Hour.	Outside Temperature.	Temperature of Water in Canteens.															
		A	E	G	H	I	L	Q	R	S	T	U	V	W	X	B	A-I
8.30 a. m.	+25	60		60	60	60	60	60	60	60	60	69	60	60	60		
10.00 "	20	42	48	52	42	46	42	42	44	42	46	48	40	32	42	50	48
11.00 "	26	38	36	48	42	44	42	42	42	42	44	46	38	32	34	50	34
12.00 m.	12	36	32	38	38	42	40	42	40	40	44	44	36	32	32	46	32
1.00 p. m.	32	40	34	42	40	40	40	40	40	40	42	52	36	38	32	46	34
2.00 "	30	32	32	42	38	42	38	40	40	38	42	44	36	34	32	42	32
3.00 "	31	32	32	40	38	38	34	40	38	38	40	40	35	32	32	38	32
4.00 "	32	32	32	40	38	38	34	38	38	38	38	38	34	32	32	36	32
5.00 "	32	32	32	38	36	36	34	36	36	38	38	38	34	32	32	34	32

Practical Service Conditions Simulated by Tests of Canteens.

In making tests of canteens and canteen flasks, effort has been made to simulate conditions of military service as nearly as possible. In every test it has been assumed that a soldier is equipped with a canteen capable of holding about three (3) pints of water; further, that he is in the open air for a period of eight (8) hours, at the expiration of which time his canteen has either been emptied, partly emptied, or refilled. In some of the tests it has been assumed that the season of the year was summer; in other tests that the season was winter.

All canteens, or canteen flasks or water bottles, have been subjected to the same, and uniform, tests. In my tests, the present regulation service canteen has been included; this to aid in considering the question of relative merit. The canteens have not been of the same dimensions or capacity, but the tests have been so varied as to insure fairness,

Methods of Testing Canteens, Canteen Flasks, Water Bottles, Etc., Intended for Use in the Military Service, Observed at Headquarters, Department of Dakota, St. Paul, Minnesota.

Every part of each canteen, flask, inner cover, outer cover, cork, etc., was examined as to material, quality, construction, weight, etc.

Capacity of flasks in fluid ounces noted.

Weight of felt, canvas, duck, or other material employed as covering, separately taken, when saturated.

The canteen was then immersed for period varying from thirty seconds to twelve (12) hours, and the total weight taken.

The canteen flask was then filled with water, the temperature of which varied from 40 degrees F. to 178 degrees F., and exposed usually for a period of eight days, each canteen having an exposure each day of eight (8) consecutive hours to an open air temperature varying from minus 10 degrees, F., to plus 125 degrees, F.

In some cases the canteen flask was not filled when so exposed. In some cases hot coffee or hot tea was used instead of water. In some of the tests the exterior surface of the canteen was wet before the test. In some of the tests the exterior surface of the canteen was dry before and during the test. Experiments were made with both wet and dry covers.

Tests were equitable and impartial. No unfair interference with any canteen during a test—as by wetting or adjusting—was practiced. When conditions or positions or environments were changed during the progress of a test, record of same was noted and made.

In some of the tests the canteens were suspended from a trestle or tree, where free circulation and exposure to air, light and heat or cold, was maintained, without contact, for several hours.

Some of the tests involved attaching the canteen to the saddle and subsequent transportation for several hours, the canteens being attached in such a manner as to receive warmth from the body of the horse.

In some cases the filled, or partly filled, canteen was thrown into an army wagon and so jolted around for a day—more or less—on a hunting or fishing trip, the tests being made during the trip or immediately at its conclusion.

Mercurial thermometers were used in testing, uniform make, selected for uniform readings. None others employed.

Beside each canteen, or between the canteens, when suspended

and whenever possible at all, a thermometer was hung from which hourly readings were taken by insertions in the fluid within the canteen. Outside temperature taken hourly on the spot. Thermometers were frequently compared and verified. See cut of Trestle used.

During some of the tests a few ounces of water were taken from the canteens every hour or so. When this was done the water was not replaced.

The tests cover a period embracing spring, summer, fall, winter, and were made in many localities.

During some of the tests the canteen was kept in constant motion by the wind, or by jolting on a moving bicycle, or by prevailing rain or snow storms. In the majority of the tests, tropical condition or frigid conditions did not have to be simulated; they prevailed.

In some cases the canteen was tested by laying on the grass or the ground, on the sand, on a window sill of granite, under canvas, on a government blanket, tent floor, house top or roof; the position being either flat, tipped up, etc. Sometimes the canteents were laid on the snow, or in contact with ice.

In exceptional cases, the canteen was placed in a hot air sterilizer, used as an incubator; or in a cold storage room, or beer vault of uniform temperature, thermometer always with it, but I have concluded that these, being artificial tests, are unsafe guides.

An exceptional manner of testing it was to place the canteen so as to receive the direct action of a fire from a fire-place or stove; or in an oven, or the direct or indirect action of a steam or hot air radiator. Some were hung over boilers in such manner as to secure high and uniform temperature. Some were exposed under glass covers exposed to the sun and so placed as to allow free access of air.

All of these tests reported from these headquarters were made by one person. No other person handled the canteens or thermometers. In these latter tests the canteens under trial, and thermometers, remained in the hands of that person.

In cases where a canteen became from any cause too leaky for further use, or burst, or collapsed, it was replaced when practicable by another of the same kind and the latter treated as a new canteen.

When a canteen passed through the regular tests, i. e., eight days of eight consecutive hours each, it was subjected to supplementary tests to determine its endurance, etc.

In military service any and every canteen is certain to be subjected to hard usage; to be knocked about, to be bent or battered; hence a fair degree of tensile strength, durability and rigidity is a requisite to be taken into consideration.

Aluminum as a Material for Canteen Flasks.

The working of aluminum by forging, rolling, stamping, spinning, casting, joining and finishing may yet include the production of an American-made canteen in a single piece suited to military service.

Of all the European countries, Italy is probably as far advanced as any in the utilization of aluminum for practical and scientific purposes. In the army, aluminum is there used to make the fuses for the shells of their guns. In the navy for searchlight purposes, furniture on board torpedo destroyers, also in the metallic part of telephone apparatus.

Aluminum is used in the British army for officers' outfits; for water bottles; cavalry mess kits; "Chitral" canteens; infantry canteens; regimental mess utensils and table ware.

The British army infantry aluminum canteen consists of an outside pot about 7½ inches in diameter by 7 inches deep, with lid and loose handle for packing, military camp kettle with folding handles and detachable spout, one set of three cups, each with folding handle, nested, and tea ball, all fitting inside kettle. In addition to the above are included 3 plates, knives, forks, dessert and tea spoons, and three condiment boxes. The whole of these are packed in the outside pot, 7½ inches by 7 inches, and the total weight is about four pounds.

One maker has designed a canteen for either two, three, or four persons, and named it "Chitral." This has proved a great success, as it is a frequent custom for two, three or four officers to mess together, and by combining they can reduce their kit very considerably. The "Chitral" canteen consists of a deep outer pot, 10½ inches in diameter by 10 inches deep, and made of stout metal to stand knocking about. The lid of this is a similar pot which drops over the top, but shallower, and thus forms a telescopic parcel, as it were, in case of extra articles to be crowded into the canteen.

Inside this pot are fitted a camp kettle, sugar, tea, coffee, and flour boxes, tea ball, three condiment boxes, cups and saucers, dinner and soup plates, drinking cups and flask, and wine mugs, these latter all nesting, liquor cups, frying pan with folding handle, knives, forks, dessert and tea spoons, and loose handle for pot and

C C

Enameled Metal Canteen flask bought by the U.S., Jan. 1900 from the Dubuque Iowa Enameling Co, Capacity 44 3/4 fluid ounces. weight, filled, covers on and dry, avoir-dupois 64 3/4. weight, filled, covers on, after ten minutes immersion, avoirdupois 75 ounces. Weight of the enameled flask, empty no covers on, 16 1/4 oz. av.

lid. The whole is held together with a stout strap and forms a most convenient parcel for transport.

A variety of other similar canteens and mess tins in aluminum are being made according to the various requirements of different regimental officers, but the above has been turned out at the rate of some hundreds per week during the last four months, and the demand is as great as ever.

Some of the larger regimental messes of the various army corps as they left England went so far as to adopt aluminum entirely in place of copper, iron, tin, porcelain, earthenware, glass, etc. I mean by this that not only were the kitchens equipped with aluminum utensils, but the officers used aluminum exclusively at the mess table. Wine glasses, decanters, milk jugs, teapots, candlesticks, trays, in fact nothing but aluminum was taken so long as makers could be found who had a stock of such articles in aluminum or could make them in the short time required.

I have had frequent conversations with officers on their return from various campaigns, both from India, Egypt, and West Africa, during the last few years, who have taken out and used aluminum kits, and they have assured me that they have no fault to find with the metal and failed to conceive why the metal was not adopted at once throughout the service.

There is every prospect for a further demand and use of aluminum for military purposes.

The British-Boer War in South Africa has stimulated a demand for aluminum field cooking and messing outfits, thus spreading the fame of aluminum and knowledge of its advantages for portable gear among a class of men who will understand and appreciate them.

The German Army, as well as the field forces of other continental powers, are equipped with aluminum, and the dead weight per man of superfluous ornamentation and equipment has been considerably reduced, tending to increased efficiency as a fighting unit.

At a meeting of the Mining and Metallurgical Section of the Franklin Institute, Philadelphia, Joseph A. Steinmetz stated that the plants now producing aluminum are those of the Pittsburg Reduction Company, at New Kensington, Pa., and Niagara Falls, N. Y.; the British Aluminum Company, of England; the Aluminum Industrie Actien Gesellschaft, at Neuhausen, at the Falls of the Rhine, in Switzerland; the Societe Electrometallurgique Francaise, at La Praz; the Societe Industrielle de l'Aluminum, at St. Michel, in France. There are also several large plants projected and in

course of construction, notably upon the St. Lawrence River, in Canada, and at Rheinfelden and Salzburg, in Germany.

The aluminum canteen flasks met the test of exposure in the open air to a temperature varying from 10 degrees F. to 2 degrees F. better than the tin flasks. In durability they would better fulfill the requirements of actual use, so exposed.

Their cost will be contingent on the market price of aluminum, which metal has been constantly cheapening since its first introduction for manufacturing purposes.

The variety of shape, construction, sizes, style, etc., of aluminum canteen flasks and water bottles is increasing, and American manufacturers have shown a determination to compete with the oldest European aluminum industries, as well as with one another.

It is claimed that it takes only one-third of a pound of aluminum to take the place of a pound of brass, tin, or copper. Assuming this, the price of one-third of a pound of aluminum compared with that of one pound of brass, copper, or tin, stands as follows: One-third pound of aluminum 11 cents; one pound of brass, 15 cents; one pound of copper, 75 cents; one pound of tin, 30 cents.

Probably some of the aluminum canteen flasks, or canteens, tested by me have been alloyed with, perhaps, five per cent of copper, nickel, or manganese, or a larger percentage of zinc added to give strength and rigidity. Canteens F, M, N, and O, appear to be a hard white alloy and are polished. Flasks D and K, also canteen L, are soft, malleable, silky, tough, and satin finished, elastic, unpolished. Their elastic qualities are especially apparent in a freezing environment when they commence to bulge, but not rupture or break, as the water within the flask begins to congeal. When the water is converted into ice, an expansion ensues, the ductile aluminum yields to the pressure, the concave side becomes protuberant and permanently swelled, bellying outwardly. The distension of flask D from this cause increased its capacity twenty per cent (20), before its eighth trial. The metal dilated,—permanently,—but did not leak, at the ninth trial. It is not resilient. See cuts D and L.

Canteen P, is unpolished. Flasks N and O do not stand up as well as the German made flasks. The fifth day of the trial showed a slight leak in each N and O,—although the firm says in a communication to me: "We beg to advise you that of the various shapes of aluminum canteens that we have made, there is not a single one that we have soldered * * * We have devised ways and means of making them water tight without solder."

At first, when flasks or canteens were tested in the open air,

when the temperament became such that they were in danger of freezing, I withdrew them; but, latterly, I have allowed them to freeze. This was to test them to the limit of their endurance and specially to discover, if possible, whether any of the so-called water-tight, one-piece, or seamless, flasks had been soldered in such wise as to show no lines of juncture, etc., visible outwardly. Also because the manufacturers alleged that they were water-tight. The number of people who want to take the United States into partnership with them in altruistic ventures is very great. Manufacturers are willing to get up so-and-so many thousand devices,—provided the United States will give a guarantee in advance. One benefactor of soldiers writes, in substance, that, knowing the dependence of man upon his canteen in an arid region, he is ready to utilize envelopes of frozen liquir air for the canteen flask, if the War Department will advance him the cost of the plant involved and necessary for the invention, which is not patented. Another suggests indurated fiber and wood pulp as the material for flasks. Another writes "I could make a canteen in two pieces that would answer all requirements. I have no money to burn, and so do not propose to experiment on same. If there was a contract in prospect,—no doubt but I should struggle for the contract."

Mr. Joseph Koenig, Manager of the Two Rivers, Wis., Aluminum Manufacturing Co., writes as follows: "We are asked by Messrs. Lanz, Owen & Co., Chicago, Ills., to make a canteen which is to hold about forty-eight ounces of fluid, and to be of seamless metal.

"We certainly think that aluminum is the proper metal, as we understand the German army is equipped with these. The same has not been manufactured, so far, in the United States; but we could do this work, if there was any possible chance of getting the government contract for the same.

"To make one of these canteens means to go to an expense of $500 for tools and experiments, and unless there is a possibility of getting a contract, it would not pay to undertake this expense. This is probably the only reason why no one has manufactured this canteen, as yet, in the United States.

"This canteen, if it be made of one piece, could not be round as the present canteen is, but would have to be oblong, being higher than wide at its widest direction; depressed on its body side, rounded on the other side.

We have no doubt at all in our mind, but that this is the can for the purpose, if spun of pure aluminum, not of any alloy of any kind.

unless the new magnesian alloy should be proven more superior than the pure aluminum.

We understand that the Government cannot undertake to give a contract before the article is made and tested, but is it not possible that the Government can advance a small amount, say $200, to produce some samples for a test?

We would then be willing to stand the rest of the expense, knowing that we would have some prospects of obtaining the contract. We do not care to spend time for experimental purposes and finally only have competitors to meet on exceptionally low rates, and have the same tendency to use thinner metal and price cutting evolved that always takes place on new articles. If this is the case, we would not care to give you any figure on the same and would not bother with them. If you will advance money on the experimental work, will go ahead after the article has developed. So far as we see, these canteens have not been made in the United States. If we did not know what difficulties were involved we would not ask you to show us consideration if we undertake these experiments and make up the tools for the article. We certainly can make the canteens; it is only a matter of cost for the tools. Cast aluminum will not stand the wear. It will corrode. The flasks will have to be spun, not of absolutely pure aluminum."

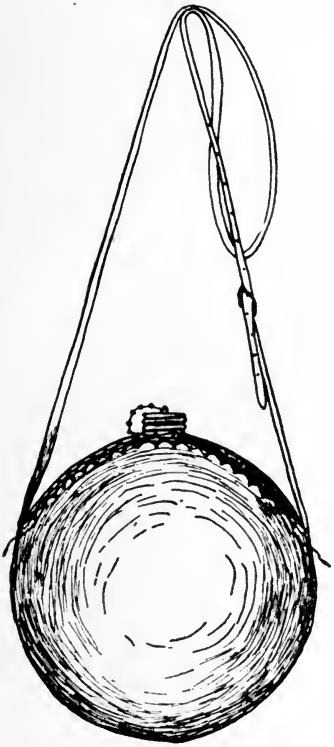
The economy attending the use of aluminum as a substitute for tin in flasks of canteens intended for use in the military service of the United States cannot be now dwelt upon for various reasons, one of which reasons is that no canteen flask made of aluminum or its alloys, made in the United States, has yet been presented to me that compared favorably with the German made canteens loaned me for trial by the Lanz Canteen Co., of Chicago, Ill.

The aluminum canteen flasks furnished me by the firm last named were probably spun; they were single piece; they did not leak; the Lanz Canteen Co. did not quote their cost or selling price.

All of the aluminum canteens from the New Jersey Co., four in number, leaked.

The same defect, viz.: leakage, existed in the trials made of the aluminum canteen submitted for test by the Broadway, N. Y. City, firm.

So far as my tests are concerned, no flask made from more than one piece of aluminum or aluminoid has withstood, without disjunctions and leakage, the variations of temperature ranging from minus 10° F. to plus 125° F. Blueprints accompanying this report show graphically that the flasks submitted for test by the Jersey Aluminum

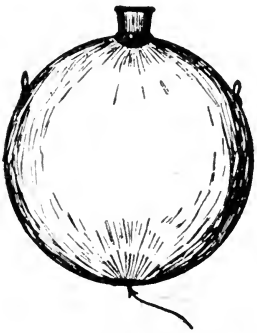


H

Arizona Canteen covered with saddlers felt; also by several thicknesses of flannel and an openable canvas cover, Lanz method. Capacity, 87 oz. weight 34 oz.

E

U. S. Army Regulation Service Tin Flask, Ordnance Pattern, no cover. Capacity 45 oz. weight 12 oz.



Arrow shows where leakage began

Scale: 1/3

Co., also the Reymond & Gottlob canteen, in common with the Dubuque Stamping & Enamel Co. canteen, also the tin flask U. S. regulation service canteen, all leaked where the pieces had been joined. The small Karlsruhe, Baden, Germany, flask, is probably pure spun aluminum in one piece. It stood the test remarkably well, bursting only after its capacity increased from 25 to 30 ounces. In Test No. 59—the capacity of Canteen L increased from 60 to 64 ounces—it did not burst.

Janney, Steinmetz & Co., Manufacturers of Aluminum.—Mr. Joseph A. Janney, Jr., and Joseph A. Steinmetz., Drexel Building, Philadelphia, Pa., were among the earliest advocates of aluminum as a metal for army canteens. The firm, at one time, had samples of the army canteens of France, Russia, Germany, England, and Mr. Steinmetz states, recommended certain canteen improvements to certain military authorities. He alleges willingness to have his foreign agents secure from military depots abroad, canteens more sanitary than the present regulation flask canteen, of which Mr. Steinmetz writes as follows: "The present U. S. Army tin canteen, which is practically the same, with its rough edges and abominably inserted, separate, neck piece, which prevents the canteen ever being drained or cleaned, is, without doubt, a worse death-breeder in our army than all the combined opposing forces that we have ever met in battle, is a matter of cheap economics. * * * Then, too, the expense of making up a lot of samples which would naturally be expected to be donated, is not to be considered from a business point of view, but the matter of the canteen has interested me very much indeed. The canteen you have in mind will certainly cost more than the present *tin death-trap*."

The Wagner Aluminum Manufacturing Co., Sidney, Ohio, advertises that its combined production of hollow-ware cast aluminum, two factories, is the largest in the world.

I am in receipt of two letters from this company and extract as follows: "We should be glad to experiment and see what could be done in the line of aluminum canteens. We do all kinds of cast aluminum work and believe it could be made much more durable, as the metal can be alloyed to give it strength. When we wrote you before, we were under the impression that it would be possible to cast them in one piece, but, after studying the matter over, we have come to the conclusion that it would be almost impossible to successfully make them in one piece. * * * We are sorry that we cannot see our way clear to experiment and see what can be done with them.

We are mailing you a copy of our catalogue and think possibly you may see something in our line of aluminum cooking utensils that could be used in the army, or possibly you could suggest some special patterns that could be made for army use. All of our goods are made of cast aluminum and give the best of satisfaction even when used very roughly, and are a great deal more durable than any stamped or spun aluminum. We believe if cast aluminum was adopted for cooking utensils in the army, they would give a great deal better satisfaction than what is being used, for they, no doubt, would be much more durable and lighter to carry."

The Pittsburg Reduction Co., Pittsburg and New Kensingston, Pa., and Niagara Falls, N. Y., Manufacturers of Aluminum.—This organization has purchased the aluminum plant of the Hill, Whitney & Wood Co., in Waltham, Mass., and will move it to New Kensington, Westmoreland Co., Pa., as the nucleus of an aluminum finishing department. Lieut. Col. Henry H. Whitney, Aide-de-Camp to General Miles, and Major Wm. C. Brown, 1st U. S. Cavalry, are acquainted with the Secretary and General Manager—Arthur V. Davis. Reports regarding aluminum articles for Army equipment have been made by the Officers named.

The Company bought a number of German canteens sometime ago, two of which are now in my possession. They are made of a solid piece of aluminum, by, I am told, Carl Berg, whose works are at Eveking, Westphalia, Germany. See Cut V.

Mr. A. V. Davis says, regarding single piece, spun aluminum flasks:

"The process of manufacture is the usual process of first spinning and afterwards pressing by means of inside pressure.

The latter corresponds in general to an ordinary stamping process except that the steel mould forming the shape is on the outside rather than on the inside. The half formed utensil is put into the die and pressure, usually by means of water, is applied to the inside of the utensil until it swells out and conforms to the shaped outside and retaining mould.

This company expects to take up the manufacture of single piece canteens, provided there is a possibility of introducing such into the Army, the object, of course, being profit to itself alone.

In a recent communication the General Manager also says: "In regard to cast aluminum, we think it has both commercial and me-

chanical objections. Cast aluminum, like any other cast metal, is more or less porous, and we take it that chances of leaks in defective utensils should be permitted. Furthermore, to make a cast utensil requires at least a thickness of 1-16 inch and usually $\frac{1}{8}$ inch, and this runs the weight and consequent expense to a high figure.

"In regard to the use of tin, we take it that the objections are not at all on the score of corrodibility, but on account of the mechanical quality of softness. A canteen made of sheet-tin (I suppose, of course, you mean pure tin and not tin plate, the rusting objections to which are obvious) would be too soft for practical purposes. It would be nearly as soft as if made of lead. Furthermore the weight and price of tin as compared with aluminum would be about three times as great."

New Jersey Aluminum Company.—Mr. C. A. Kryttschnett, Manager of the New Jersey Aluminum Co., Newark, N. J., writes: "We take special note of your remarks that the German canteens have surpassed anything of American manufacture; allowing this to be so, we do not believe the American could not do equally as well if we were all given another chance. We have probably all made the same mistake of trying to produce something cheap instead of something strictly of first class quality, and, speaking for ourselves, we did not know to what these canteens might be subjected, but we knew that they would hold water; in fact, it was hung up here in our establishment for six months without any leakages; but such tests as you have given them are more severe than anything we could have thought of. This is why we wrote you as we did that your tests would be valuable to the manufacturers of canteens. We should very much like to have another trial at it, and, if possible, to have you send us one of the German canteens; perhaps we might even improve on the same. Furthermore, we believe it only to be fair and just to American manufacturers for Uncle Sam to patronize home industry. We feel confident that canteens can be made in this country that will meet all requirements."

Cast, vs. Stamped, Aluminum.—The Griswold Manufacturing Co., Erie, Pa., for the production of the "Erie cast aluminum ware; New York warerooms, 294 Pearl St., writes as follows: "We do not make anything in the way of an aluminum flask. This would naturally be made of our stamped ware."

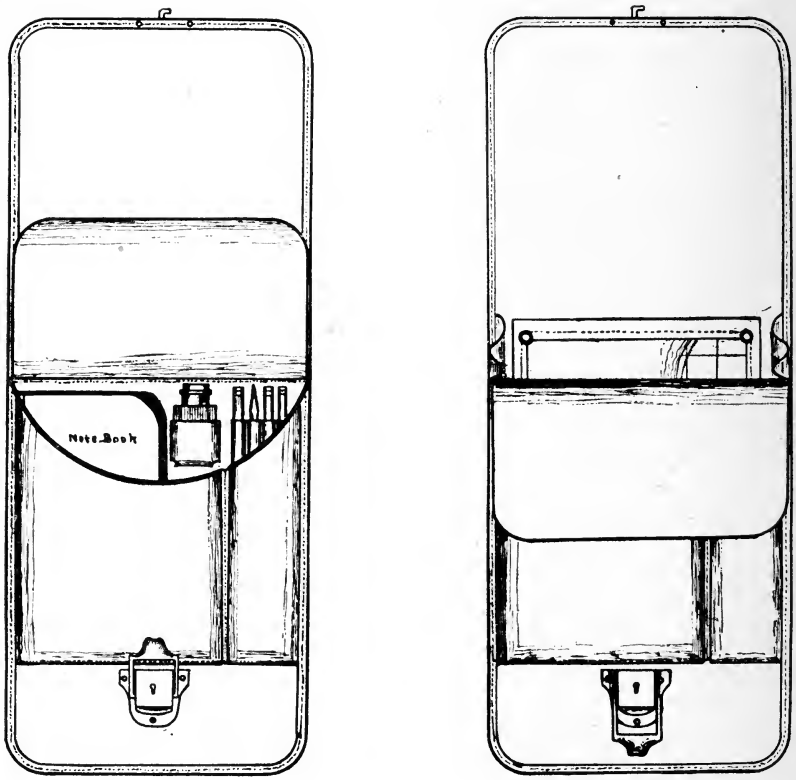
The firm claims as a few points of merit of its hollow aluminum

cast ware as follows: "Each piece is cast solid in one piece, leaving no seams or points to leak. Being cast, it is strong and stiff and cannot be annealed by heat, while thin stamped aluminum ware warps and becomes soft after being heated. Aluminum as a metal leads for cooking utensils. The 'Erie' ware does not tarnish and can be kept bright by cleaning same as silverware. It is solid, without plating; no plating or enamel to wear off; no poisonous metal; they are absolutely pure and will last for ever; cast all in one piece; no seams or rivets to leak; no enamel to flake off; rivets are cast on the outside of the piece, leaving no marks inside; light and strong; either polished or satin finish; fruit acids do not affect it; will not tarnish; no solder used; no rust; practically incorrodible; no cracking or shelling off, all of the porcelain, agate and enameled ware of various kinds shell off, the cause being that the latter (like the Dubuque Stamping & Enamel Co. canteen) are a combination of mineral and metal, one expanding under conditions which make the other contract, and vice versa, resulting in a general disintegration of the whole."

The firm claims that the superiority of the "Erie" cast aluminum ware over the stamped aluminum ware is manifest by the following physical property of the metal:

Aluminum hardens remarkably when it is being worked by pressing, forging, rolling, stamping, or other similar treatments. The working imparts stiffness or temper, same as in high brass or copper. A vessel made from sheet aluminum, stiffened as above, when it is put over the fire and heated and then allowed to cool, is annealed; after heating a few times it becomes soft like lead, whereas the metal in the cast ware is melted and chilled in the mould and cannot be annealed. Again, to make a casting, it is three or four times thicker than the stamped, therefore it is stronger, holds and conducts the heat better and is less liable to burn or scorch. Lastly, much better shaped vessels can be made by casting than by stamping. Cast ware, though higher priced at first than stamped, is cheaper in the end. An extraordinary feature of aluminum is its heat-retaining or non-radiating attributes. Aluminum discoloration can be prevented with one-half the care bestowed on other metals by using liquid solerine to clean with.

Aluminum solder for Canteens.—A satisfactory solder for use on any metal should fulfill the following requirements: 1. It should fuse readily. 2. It must alloy easily with the metal, in common parlance it must "bite." 3. It must be tough. 4. It must not disin-



The Lanz Sabretache, or Dispatch Holder, for the use of Mounted Officers U.S.A.

Scale: 1/3

tegrate. 5. It must have the same color as the metal. 6. It should not discolor with age. 7. It should not be too expensive. 8. It must flow into a joint. 9. For joining aluminum, it must stand very near aluminum in the electro-chemical series, particularly zinc, and carry its own flux.

Since aluminum has become a common metal, numerous inventors and metallurgists have endeavored to produce a solder which would unite pieces of the metal in the same way that brass, tin, and other metals can be joined by a tin-lead solder. Most of the solders produced have required the use of a blowpipe, or special tools or fluxes, which are not handy for metal workers. All have disintegrated after the canteen flask has been filled for five or six days with water. Most of the solders contain lead, tin, bismuth or phosphorous, and discolor with age.

The "Aluminum World," published at 218 William St., N. Y., is authority for the statement that, although there are a number of solders in the market, and one new one which promises good results, no solder has yet been produced that is valuable for canteen purposes, the defect being that they did not hold when the joint got wet, there being a galvanic action started between the aluminum and the solder.

The Hill, Whitney & Wood Co., 115 Bacon St., Waltham, Mass., manufacturing specialists in "Aluminoid," also pure Aluminum, either cast, stamped, or spun, write as follows: "We do not know of any real practical solder or method of soldering aluminum canteens. There are two or three different solders, but none of these work satisfactorily, or are practical for work of that kind. Richard's solder, sold by Janney & Steinmetz, Drexel Building, Philadelphia, and Green's solder, sold by Edward N. Cook, 144 Pine St., Providence, R. I., are the best we have used. A new solder has come out recently called the "McAdamite Solder" (W. A. McAdams, 987 Kent St., Borough of Brooklyn, N. Y.). We have never tried this, but have a sample in our office which we will try at the first opportunity.

"None of the solder we have ever had will run or flow into a joint readily, and therefore it makes a very difficult operation to solder anything, and we avoid it as much as possible.

"We make a flask in two sizes, half a pint and pint, of one piece of metal, which, of course, is much better than could possibly be made of two pieces. We have experimented a little on the line of making a canteen from one piece, but have not as yet completed our experiment. We feel quite confident we can do it all right, although

we might be compelled to change the shape a little from the regulation shape now used by the army. We shall continue our experimenting, and, if successful, will advise you later.

"We shall not consider an experiment with anything but a seamless canteen, as we do not think there is any solder that is reliable for aluminum.

"In regard to an aluminum canteen, we do not feel confident that it would be altogether satisfactory, for the reason that it discolors whisky after standing in it for some time.

"There is, however, no poisonous or injurious substance in the metal, but possibly there would not be so much whisky drank if it should be slightly discolored from the metal. I do not know that it affects the taste in the least. We have sold quite a number of flasks, and have people report to us that it discolored whisky.

"It would certainly be very much lighter than anything else used and would not rust or corrode like tin or enameled ware.

"We see no reason why this metal should not be all right for canteens. We know that the German army are, or have been, using aluminum flasks and canteens, but do not know with what success, nor whether they are made in one piece or soldered together. They can be made in that way, but it is hardly practicable."

Janney & Steinmetz, Drexel Building, Philadelphia, Pa., Aluminum Merchants, state that Dr. Joseph Richards, of Lehigh University, Metallurgical and Chemical Department, School of Analytical Chemistry, invented a solder recommended by Mr. J. C. Ashton, General Manager of the Illinois Pure Aluminum Co., the largest manufacturers of aluminum cooking utensils in the world. Further that the Richards' solder is pronounced satisfactory by the Aluminum Industrie Actien-Gesellschaft, the greatest aluminum manufacturing company in the world. Also that the Pittsburg Reduction Co. uses it. Also that Naval Contractors and Pay Inspectors, U. S. Navy, have ordered supplies of it after careful and intelligent experiment.

"It is known," say Janney & Steinmetz, "that either pure tin or pure zinc will join aluminum, and it is a very common fault to note that the bulk of the so-called solders are composed chiefly of those metals, but the use of these worthless solders has caused heavy losses to manufacturers of aluminum goods."

The lack of an easy solder more than anything else retards the use of aluminum as a material for canteen flasks in the United States. On the other hand, the German Arms and Ammunition Factories, Berlin, Karlsruhe, write: "We will shortly manufac-

ture an aluminum flask No. 16, capacity 1.5 liter (50 oz.), with rings, and another one with loops (or ears), as samples. See blueprints "W" and "X," herewith. The date (on specifications) furnished by you, regarding the execution of the flask will, as far as practicable, be taken into consideration, and, upon completion of the samples, we will communicate to you our experiences gained during the manufacture of the same. Later on, we will submit to you counter propositions. The cork (or stopper) can be fastened to the neck with a light chain."

The soldering of aluminum is not easy; cannot be done by a single modifications of old methods, such as soldering tinned iron. Aluminum is like copper and black iron, not like tinned iron, and the edges to be joined must be cleaned and hot and tinned (or coated) and otherwise prepared for soldering; no flux of any description, either on the metal or on the joint, being used.

The property of aluminum which renders soldering so difficult is very probably its easy oxidation. Although apparently resisting oxidation very strongly, yet this resistance is not a simple process. When a clean surface of aluminum is exposed to the atmosphere it is instantly covered with a film of oxide, which, being continuous and unalterable, protects the metal beneath it from further oxidation. This film or oxide acts effectually to prevent any other metal from coming in close enough contact with the aluminum beneath to alloy with it, and thus soldering is prevented. The use of a flux to dissolve the oxide has been tried under all conditions, but none known to the writer have been found practicable. The Richards' solder was made upon the conclusion that that solder should contain its own flux, so that the instant the film of oxide was removed the solder proper would be simultaneously present to take hold of the aluminum surface at the same instant it was cleaned from oxide. A percentage of phosphorous was added to the alloy. Letters patent on the use of an oxidizing agent, such as phosphorous in solder, were granted in July, 1892—No. 478,238.

The McAdamite Solder for Alluminum or its Alloys.—Mr. W. A. McAdams, 978 Kent Ave., Borough of Brooklyn, N. Y., advertises as follows: "Upon large articles it is best to tin or cover the articles with the solder by a copper soldering iron. Then to melt them together by a hand brazing blow-pipe. This consists of two pipes, one for gas and the other for air, which combine into one mouthpiece for the blue flame. This to be blown by the mouth or foot bellows. This hand brazing blow-pipe is much used for brazing

bicycles. This blow-pipe needs to be moved by hand along or about the joint or seam while the work remains still.

A very neat way to do some kinds of work is to follow the iron in the act of tinning (to cover) with a cloth and wipe off all the solder from the surface possible. When this is done on both the surfaces to be joined, lay in a piece of sheet solder and then melt the parts together by a mouth blow-pipe, or other means of heating. This sheet solder will be sent at enough extra cost to cover the cost of rolling.

"To solder a long seam edge to edge. This is quite difficult to do because of the expansion and contraction of the sheet metal. First clean, and then tin the edges with the solder, lay the work, if possible, upon asbestos board, and tack in places along the seam by soldering and then fill in the spaces between. Use a soldering iron."

"Do not use any fluxes. This solder contains its own flux. Let it be clearly understood that these solders do not flow into a joint or seam; they must be put there.

"All these solders are wonderfully strong and permanent. They are warranted to last as long as the aluminum itself. There is no decay or disintegration. They do not discolor by time. They are almost the same color as the aluminum, and take a good eye to see the solder in a finished off seam. There are no stains to remove.

"These solders contain no lead, tin, bismuth, aluminum, or phosphorous.

"They will solder aluminum to aluminum, or any of its alloys to each other, or all of them to brass or zinc, or brass to brass, or zinc to zinc, or all of them, whether they be cast or wrought, to each other indiscriminately, and do all of them strongly, permanently and well, provided that in the case of the aluminum alloys, the aluminum is the largest part of the alloy. Brass to brass is more strongly soldered than by common tin and lead solder.

"There are three grades of McAdamite solder:

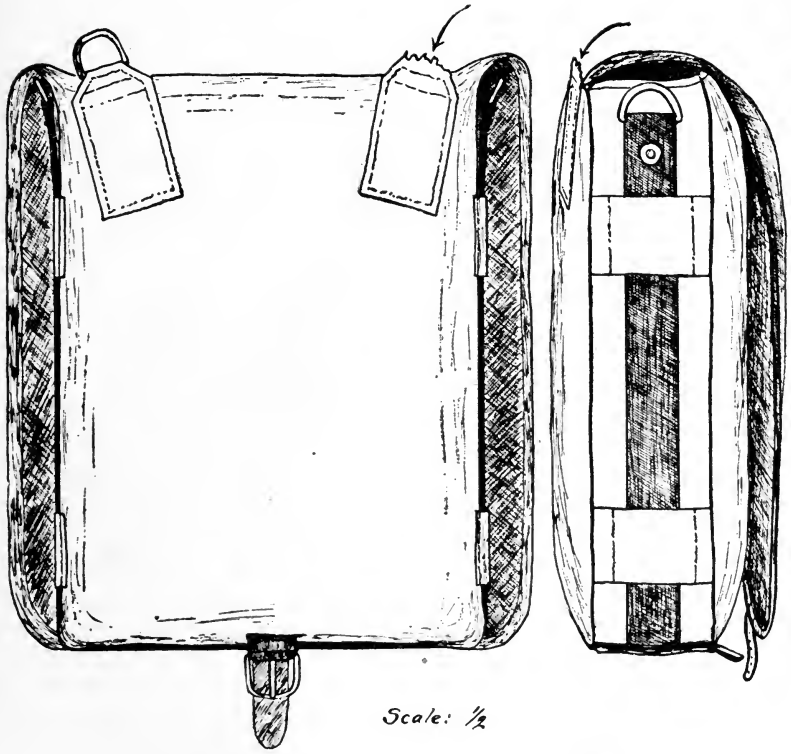
"No. 1, melting at 430 degrees F., for very thin articles.

"No. 2, melting at 550 degrees F., the best of the three for general use.

"No. 3, melting at 610 degrees F., the strongest of them all.

"Sent by mail at 25c per ounce, or $3.00 per lb., upon receipt of price. Sent by freight or express at buyer's expense in ten pound lots at $2.25 per lb., or $22.50. No samples sent."

The L. F. Altpeter Solder.—L. F. Altpeter, 758 So. Halsted St., Chicago, Ill., says in the "Aluminum World" regarding his hard



The Lanz Carry Strap for Haversacks.
(*Arrows show where the weak points of the present pattern of regulation service haversacks are. The function of the carry strap is to strengthen and support the Haversack.*).

and soft solders, that a soldering iron, blow-pipe, or lamp flame can be used. He claims a process to solder copper, brass and other metals to aluminum.

Greene's Aluminum Solder.—Is advertised as being manufactured and controlled solely by Edward N. Cook, 144 Pine St., Providence, R. I., and is alleged to be recommended by the Pittsburg Reduction Company.

Eugene M. Totten's Compound for Soldering Aluminum.—A new compound for soldering aluminum has been patented by Eugene M. Totten, of Buffalo, N. Y. In the specifications of Letters Patent, No. 667,999, the inventor claims that he has produced a solder capable of ready and immediate use without the necessity of filing or scraping the parts and without the employment of a separate flux. The compound is composed of the following ingredients in the proportion specified: Aluminum, 20 per cent; tin, 38 per cent; zinc, 40 per cent, and a hydrocarbon, 2 per cent.

"In the manufacture of the solder, aluminum and tin are first melted, then the zinc is added, and after the reduction of the metals while still in a molten state, and without additional heating, there is added 2 per cent of the hydrocarbon, which is mixed with the other ingredients into a homogeneous mass. This latter ingredient may be fat, wax, parafine, or any other species of hydrocarbon. It has been demonstrated that the addition of a hydrocarbon to the alloy, by increasing the amount of carbon reduces and removes the oxides, which would otherwise form on the melted metal, and in consequence the compound, when cool, is white and free from oxides when solid. It is the carbon alone which effects the reduction of the metallic oxides formed on the surface of the aluminum parts to be soldered, and the scraping of such parts is rendered unnecessary, because of the non-presence of oxides in the soldering compound made."

The James Gibson Slater Aluminum Solder.—Mr. James Gibson Slater, whose residence is 793 Manning Ave., Toronto, Canada, showed some samples of soldered aluminum. Mr. Slater had joined with a one-inch lap, sheet metal, sixteen inches in length. The pieces were soldered with a copper soldering iron. From the appearance of the articles the solder seems to flow into the joint, and it is nearly of the same color as aluminum. Mr. Slater guarantees that it will hold under varying conditions. He can solder different

metals to aluminum, and showed an aluminum faucet soldered to a lead pipe. He makes an alloy of aluminum, which he calls "Luminoid."

The Julien Novel Aluminum Solder.—Julien Novel, of 15 Rue des Grottes, Geneva, Switzerland, has invented a flux for soldering aluminum to aluminum, or to other metals, after the metals have been tinned. The tinning and soldering fluxes are composed of stearic acid five parts, resin two parts, and oleic acid one part. The usual soldering metals are employed, such as silver solder, copper or hard solder, and tin solder.

SOLDERING ALUMINUM.

Prominent among the peculiar characteristics of aluminum, as compared with other common metals, is its physical reluctance to the acceptance of a fusible alloy that will satisfactorily unite its surface or margins. Indeed, the lack of a perfect solder has seriously retarded the development and manufacture of articles made from sheet aluminum when their shape or contour is to be accomplished by the uniting of separate pieces in the evolution of the finished product.

Aluminum is unique among the sheet metals of commerce in this respect, and a casual consideration of its physical properties will be necessary for an understanding of this difficulty. The reasons that aluminum is a refractory metal to solder are entirely physical. It is extremely difficult to expose a bare surface of aluminum to the action of a solder, although the mechanical difficulties of grease and dirt are quickly and easily removed, and need not appear as features in the problem.

Upon attempting, with any ordinary solder, to join sheets of the metal, it is noticeable that the mixture does not take hold, but tends rather to run off, or perhaps it will chill, utterly refusing to tin the sheets, and rarely adhering to the aluminum. The reason of this behavior is that there is always present a thin continuous coating of oxide, which effectually prevents the solder from getting to the true metal beneath. This thin, almost invisible skin of alumina, or oxide of the metal, is of instantaneous formation, and the surface of the metal may be scraped or filed without even temporary relief because of the immediate renewal of the coating.

The use of fluxes and acids to overcome this difficulty have been repeatedly suggested without securing satisfactory results, and a new theory tending toward the solution of the problem must needs be

approved. Dr. Joseph W. Richards, of Lehigh University, Bethlehem, Pa., conceived the successful practice of overcoming the difficulty by incorporating into the composition of the solder an ingredient that would remove the oxide film during the process of soldering, thereby preserving the surfaces clean until the union of the parts had been accomplished. The solder devised and patented by Dr. Richards carries in its make-up an alloyed flux of phosphorous in tin, the theoretical necessity of the simultaneous action of the flux and the taking hold by the solder being confirmed during many years by the satisfactory results obtained in actual commercial practice.

The high heat conductivity of aluminum is another characteristic of this strange metal, and the refusal of many solders to perform their expected duty is traceable to it. The aluminum quickly and readily absorbs the heat from the soldering iron, and the temperature of the tool is thus so far reduced that the solder "freezes" at the joint and failure ensues. To overcome this difficulty, which arises in large work particularly, it is necessary to keep the soldering iron very hot, and oftentimes it tends to the betterment of the result to apply heat likewise to the parts to be joined.

Aluminum is a highly electro-negative metal, and it is this property that, in addition to causing the instantaneous formation of the thin skin of oxide already mentioned, tends to operate in another way, quite as disastrously, by setting up a galvanic action at the joint, between the solder and the aluminum, inducing failure through rapid disintegration. Therefore, in devising a solder, it is plain that it should be composed of those metals nearest to aluminum in the galvanic series in order to reduce this disintegrating action to a minimum. Accordingly zinc suggests itself as an excellent base.

Almost any one can solder aluminum by such simple means as using pure zinc or pure tin, or both in combination, and joints of accuracy and strength have been thus obtained. Upon these results, which are at best but temporary, yielding soon to the disintegrating influences above noted, have rested the reputations of many of the so-called aluminum solders of commerce.

It is not the purpose of these remarks to schedule the proportions of the various metals in the many alloys offered on the market under the name of solders, but rather to show, in a general way, the reasons of their repeated failures, and to suggest lines of thought and experimental work most likely to be productive of sensible results. To be a commercial success, any solder must conform to the

following requirements: It must take hold easily upon the aluminum; it must be conveniently handled without complicating tools or sundry fluxes; it should melt readily; it must be strong, malleable and tough; it must not combine elements inviting disintegration; it should be of the same color as aluminum and it should not tarnish with age. To all of these conditions, Joseph Allison Steinmetz says, Dr. Joseph Richards' solder conforms.

W. C. Heraeus' Process for Welding Aluminum.—Mr. Heraeus has platinum works at Hanau, Germany. Agent in U. S., Mr. Charles Englehard, 41 Courtlandt St., New York City. It is claimed for the Heraeus process of welding aluminum, that the seams are united so intimately that they disappear and can be further shaped by hammering. Soldering aluminum, apart from all other difficulties, has the disadvantage that its powers of resistance at the soldered places is weakened against the influences of the atmosphere and those of a chemical nature. This disadvantage is obviated when the metal is welded. The process is applicable to sheet, wire, thick plates and heavy bars. Aluminum cannot be used where it would come in contact with alkaline substances that attack it. In the resistance it offers to acids it resembles copper. Sulphuric acid has but little effect on aluminum. When copper is exposed to air and moisture, poisonous verdigis will form, which is not the case with aluminum. Repairs by the Heraeus welding process can be easily done. Certain waters and acids corrode aluminum, but the metal displaces copper when it comes in contact with neutral substances, as spirits, sugar solutions, ether, glycerine, stearine, wax, beer, etc.

Richards' Hardened Aluminum.—The Delaware Metal Refinery of Philadelphia (18th St. and Washington Ave.) are selling considerable quantities of hardened aluminum alloys, made after the formulas and under the direction of the superintendent, Mr. Joseph Richards.

The principal constituents of these alloys are aluminum and zinc, in varying proportions, made from the purest metals, very thoroughly alloyed and carefully cast. The idea which Mr. Richards had in view in producing them, is to provide a series of perfectly reliable and uniform alloys, from a very hard rather brittle alloy, to a strong, tough softer alloy, thus forming a complete series adaptable for the most varied applications. These alloys all approximate toward aluminum itself in weight, and duplicate the alloys from soft brass to the hardest of the regular bronzes in strength and toughness.

Metallic Flask with telescopic cup and top combined. Submitted by the Lanz Canteen Co., Chicago, Ill., Capacity 10 oz.

Nine grades of alloys are made, numbered respectively 1, 2, 3, 4, 5, 6, 7, 8 and 9.

No. 1 is the hardest. It looks like polished steel, takes a brilliant polish and has a hard surface. It can scarcely be cut by a knife. It is almost as rigid as steel, and machines like a fine quality medium hard steel. Its specific gravity is 4, or just half that of brass or bronze. It is the cheapest of the alloys, costing less than pure aluminum, and objects made of it cost considerably less than if made of brass or bronze.

No. 4 is a milder alloy and probably the one of the series having the maximum of working strength.

ALUMINUM UTENSILS.

Aluminum utensils are claimed by manufacturers to be the only ware that is *unobjectionable in every respect.*

Arsenic and Lead in Enameled Ware.—Joseph Stanton has examined in the laboratory of the Massachusetts College of Pharmacy, the iron enamel covered utensils so much used in the kitchen. On the Boston market were found thirteen distinct brands of this ware. These, when tested, gave the following results: Eleven contained arsenic, two contained lead, and two were free from both arsenic and lead. The two that contained lead also contained arsenic. The approximate amounts of arsenic, as indicated by comparison of the mirrors, obtained with mirrors made from known quantities of metallic arsenic, varied from 1.3200 to 1.500 of a grain in each two grams of enamel. Professor Baird in making this report (at the last meeting of the Massachusetts Pharmaceutical Association) said: "In this connection it would be interesting to know whether the arsenic and lead are in such combinations as to allow their solubility in the fluids which come in contact with them in ordinary cooking. As the enamels seemed to be quite easily disintegrated by the mineral acids, it is quite probable that from them these poisonous metals would be found to dissolve in dilute fruit acids and dilute alkaline solutions, and that in this manner they may become a source of arsenic and lead contamination." It was also said in this report: "In former years arsenic and lead were both very common ingredients of enameled wares, especially the latter metal. In fact, compounds of lead were used to such an extent that the lead could be extracted by boiling with dilute fruit acids, and lead poisoning from this source became so frequent that certain countries made laws restrict-

ing the sale of enameled wares containing lead in soluble form."—"Druggists Circular and Chemical Gazette."

The "Review of Reviews" says: "Probably the most important use to which aluminum will be put, at least in the immediate future, will be for culinary and household utensils. Besides being very light, and hence far less cumbersome than any other metal of equal strength and durability used in cooking, *aluminum is practically incorrodible.* Professor Jamieson asserts that, *no food now known to man can effect this metal in the slightest degree. It is wholly free from every form of poison and will not taint food.* These are qualities that are possessed by neither iron, copper, tin, nor lead. Furthermore, it is a better conductor of heat than either of the other metals."

"The poisonous substances in the enamels are said to be arsenic, antimony, and lead. Neither of these is nutritious, and food is better without them. It may be that some of the slight and unaccountable illnesses that have come to people especially after eating sour fruits and vegetables boiled or stewed in these dishes—tomatoes, rhubarb, strawberries, compounds flavored with lemon—have their origin in disintegration of this enamel and in the absorption by the food of the arsenic or whatsoever else is employed in it. Even where the enamel is commonly applied with skill and understanding it may happen that a workman may spill an undue quantity of poison into the mixture, or that the fusing may be imperfect; and it does not take much arsenic or lead to cause illness, while a succession of poisonings may result in lifelong stomach trouble."—"Brooklyn Eagle" Editorial.

Enameled canteens were purchased by the United States from the Dubuque Enameling Co., in December, 1898, also in October, 1898, likewise in January, 1900. (For description of the Dubuque Enameling Co. canteen see page 9 of this monograph). They were issued for trial. No reports of results of trial, if made, have since reached the Rock Island Arsenal. The canteens made in October, 1898, at the Rock Island Arsenal had a special wide mouth to admit certain filters purchased from Mrs. Caroline Parker. (See page 8, this report, under subhead "The Parker Canteen.") In August, 1900, some more filters were purchased from Mrs. Parker and from the Dubuque Enameling Co. a special canteen for them. These, too, were issued for trial.

The Dubuque Enameled Canteen Co. is profiting by the facts advanced by the parties who recommend the Lanz method in this notable respect, viz: They put Petersham felt on what was, at

first, a naked flask, and they not only place two pieces next the flask, but they have added an extra piece of felt, forty-two inches long by one inch wide, as an inner band, thus increasing the absorptive powers over those possessed by the regulation canteen.

This adoption of the method and system whereof Mr. Lanz is the originator, exponent, advocate, and patentee, is an admission of much significance and highly complimentary tc Mr. Lanz. That the Ordnance Department and Board of Fortification and Equipment concur is evinced by the fact that so many of the enameled canteens have been purchased by the United States.

As the enamel canteen with regulation cover is heavier than the regulation canteen; further, as any enameled ware having arsenic, lead, or antimony in its composition is dangerous to health; still further, as the enamel will chip off and the iron part rust; there do not appear to be any points of advantage favoring the further trial of the Dubuque, Iowa, Stamping & Enamel Co. Canteen, with a view to its adoption for use in the military service of the United States.

Aluminum Coated Sheet Steel.—The Aluminum Coated Sheet Steel Company, Connelisville, Fayette Co., Pa., claims that "this product is superior in all respects to galvanized. That it contains all of its merits with none of its defects. That it can be heated to a red heat without destroying its coating. That sulphurous gases, brine, salt, and acids do not affect it as readily as they do galvanized. That it can be soldered with common solder. That it will stand even severer tests than any coated metal. That no coated metal can be seamed or hammered down flat and then bent back straight without flaking. None but solid metal will do this.

That, *Aluminum Coated Steel Sheets can be bent or seamed* in any way required in actual work and the coating will remain intact on both sides. But no coated metal can be bent flat on itself and return to its original shape without showing fracture in coating. This is not necessary and if Aluminum Coated Sheets are given the same work as galvanized they will prove in every way superior and all we claim for them.

That any intelligent metal worker will recognize these facts and will not expect impossibilities."

This firm gives the following directions for flux to solder this metal: "Dissolve as much spelter as your muriatic acid will take up. Use the same without diluting with water. Never add fresh

acid to blacken your metal. Other fluxes, such as rosin, and palm oil, may be used with success."

The following is a copy of a communication addressed to the Patton Paint Company, Milwaukee, Wis.:

It may be an advance backward to construct a soldier's canteen of wood.

I enclose cut of a canteen carried by the U. S. Army during the period of our second war with England, 1812, by reference to which you will see that it was then composed of many pieces, like a barrel, tub, firkin, fig drum, etc.

Could you not get one constructed of suitable wood or indurated fiber or wood pulp, turned in one piece, painted by your process inside and out?

The normal use of the canteen is to carry water, coffee and tea. Government does not contemplate furnishing the soldier with a water bottle, the lining of which should be capable of resisting the action of whisky or other alcoholic fluid.

A wooden water bottle was carried for years in the English Army, the exterior of which was painted blue; but before I should feel justified in recommending a return to a canteen made of wood instead of sheet tin, I would have to be satisfied that one constructed of this material would meet the requirements of durability, etc.

I would be glad to have you institute a series of experiments whereof you write, looking toward covering both the inside and the outside of the flask in such a way that it would resist the action of everything including distinctly acid fluids.

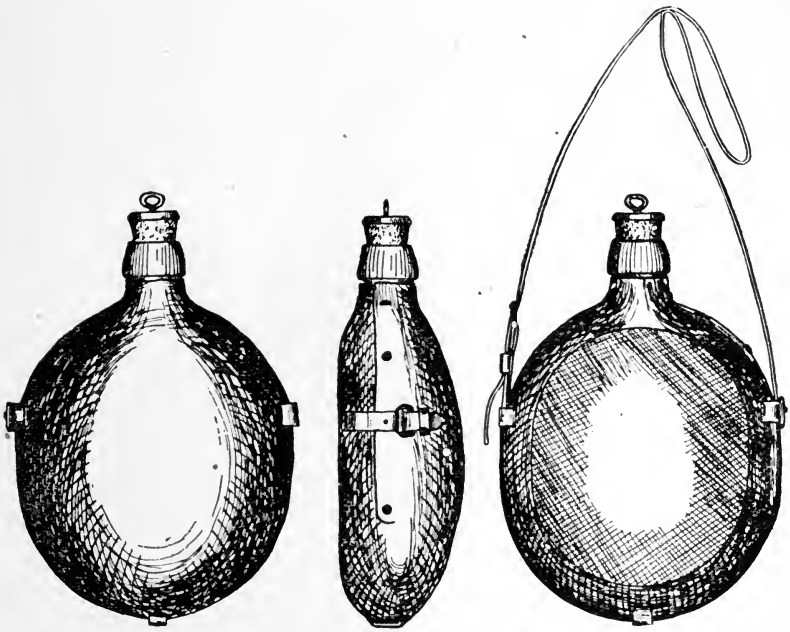
Whatever canteen is adopted for the use of our soldiers will have to be provided with a non-conducting cover.

To the above the Company replies as follows:

"We thank you for the blueprint received with your letter, and hope soon to begin our experiments as to covering inside and outside in such a way that the covering will be impervious to the action of everything except fluids which are distinctly acid or alkaline.

"It is easy enough to begin a series of experiments, but it takes a long time to complete them. We would not be satisfied to report on anything in the way of a test of permanency under six months or a year of constant use for the purpose required, as we carry on our experiments.

"We will let you know from time to time how we are progressing



— V —

Single piece. Aluminum Canteen. German Army Regulation pattern 1899. Manufactured by Carl Berg, Ereking, Westphalia, Germany. Covered with grayish felted cloth, single thickness. Furnished with black leather loops and strap. Capacity, 25 fluid oz. weight 7 ¾ oz.

Scale: ½

and will hope to be in a position to make a definite statement as to what we can do within perhaps eight months from this time."

Disadvantages of Aluminum as a Material for Canteen Flasks, from a Mechanical Point of View.

After a metallurgist has placed in the hands of the inventor a metal lighter than tin as a material for a canteen flask, the artisan encounters a mechanical difficulty, to wit: In attaching ears, or side pieces, to the flask.

There must be something connected either with the flask, or its cover, to fasten the canteen strap or sling to—unless the latter goes round the canteen as in the 1864 period of the U. S. A.

There are two natural ways of slinging a canteen; one way is from the shoulder, the other way is from the belt.

In either case, the strap must have a method of attachment, as by a hook or snap, with the canteen flask or with some portion of the canteen cover; otherwise the strap must encircle the canteen.

This attachment necessitates loops, rings or triangles, eyes, openings, etc., on the canteen cover, or ears, metallic side-bar attachments, or other fastening device, directly connected with the canteen flask; hence attached to the latter by solder or rivet.

A disadvantage of aluminum as the material for a canteen flask is that with the present limited knowledge of this metal, it cannot be so soldered to itself as to resist water action. Galvanic action occurs between aluminum and any known solder when wet for a considerable period. Disintegration follows.

This should prevent the adoption by any army of an aluminum canteen flask any of the parts of which are joined by soldering.

As solder fails to assure a permanent union of aluminum to aluminum, rivets are resorted to in order to fasten the side-ears, or other metallic contrivance, to the aluminum flask. This is practical, but not believed to be enduring. Leakage follows. A method of reliably fastening ears to an aluminum flask is unknown to me.

Tin as a material for a canteen flask does not present any of these disadvantages.

Reason Why Old Pattern Canteens Have Been Retained in U. S. Army Since 1874 or 1878.—Past attempts to improve, change or retire the army canteen have been blocked by two things, viz.: The representation by a Department head that there were already on hand a large stock of old canteens; hence these unissued relics

of a past period ought, in economic interests, to be disposed of first.

Second: The recommendation of the Commanding General that the old stock be disposed of before incurring the expense of a new, or later, pattern.

Finally: The orders of the Secretary of War directing that future issues of canteens be confined to existing patterns in stock, and prohibiting any expenditures for new patterns. This injunction applying also to other Infantry and Cavalry equipments.

Efforts Made in 1878-9 to Change the U. S. Service Canteen.— In General Orders No. 76, Headquarters of the Army, A. G. O., July 23, 1879, there were published extracts from the proceedings, embodying the conclusions, of the Board of Officers convened in Washington, D. C., by Special Orders on Nov. 11, 1878, "for the purpose of considering the whole subject of * * * the equipment of troops generally"; together with the comments of the Chief of Ordnance, the General of the Army, William T. Sherman, and the indorsement of the Secretary thereon.

The Board found the weight of the canteen, half-filled, to be two (2) pounds eight (8) ounces.

The recommendations of the Board were disapproved by the Chief of Ordnance, there being then on hand, left from the Civil War, 267,000 canteens which, in the opinion of General Benet, ought to be used up before others were provided.

The recommendation of the General of the Army was: 28 "That no other change be made in the present infantry equipment, though a lighter canteen would be desirable." General Sherman commented (see page 40, G. O. 76, A. G. O., series 1879): "The old pattern articles, that is canteens and such, can be issued till exhausted, and the new ones will then follow naturally and without sacrifice on the part of the United States, or of the officers and men who compose the army."

The views and recommendations of the General of the Army were approved July 19, 1879, by the Hon. G. W. McCrary, Secretary of War, who indorsed the recommendations made by the Board, the Chief of Ordnance, the Quartermaster General of the Army, and General William T. Sherman, as follows: "No change will be made at any time which involves expenditure not clearly within existing appropriations, and great care will be taken to avoid a deficiency."

On Oct. 7, 1873, the Chief of Ordnance, U. S. A., Brigadier-

General A. B. Dyer, recommended that a Board of Ordnance and Cavalry Officers be assembled to consider "What changes," if any, should be made in * * * cavalry equipments and accouterments, as published by G. O. No. 60, War Department, A. G. O., June 29, 1872.

Board was convened by Special Orders No. 238, Nov. 29, 1873, modified by Special Orders No. 253, War Dept., A. G. O., Dec. 24, 1873. Report of proceedings made from Watervliet Arsenal, West Troy, N. Y., May 5, 1874, by Colonel I. N. Palmer, 2d Cavalry, president of the Board. The Board consisted of the following: Col. Innis N. Palmer, 2d Cavalry; Capt. J. J. Upham, 6th Cavalry; Capt. A. Mordecai, Ord. Dept.; Capt. Guy V. Henry, 3d Cavalry, and Capt. L. H. Carpenter, 10th Cavalry; also Capt. William Hawley, 3d Cavalry, in place of Major Henry, relieved.

The proceedings of the Board, with the action of the War Department thereon, were published in Ordnance Memoranda No. 18, 1874. Under the caption "Canteens," page 18, is found the following: "Canteen. It was discussed as to whether the canteen should be covered with two thicknesses, and felt was suggested as a good material." No other reference by title, to canteen is found in the published report, except, same page, the following: "A resolution was adopted requesting the commanding officer of the Leavenworth Arsenal to make for the use of the Board the following articles after description furnished: * * * One canteen with two coverings." And, on page 57, the following: "The Board is of the opinion that to the accouterments should be added a canteen of pattern and material like sample submitted." On page 18 Board expresses opinion that the regular equipments necessary for a cavalry trooper are as follows: * * * One canteen * * * On page 69, it is stated that "A personal examination has convinced the Board of the superior quality of the manufacture and material of the articles furnished from the government workshops over those obtained by contract, and it is earnestly recommended that, as far as possible, all stores issued to the cavalry by the Ordnance Department may be made in the Arsenals, believing that to be for the best interests of the service."

On May 11, 1874, the Acting Chief of Ordnance, Col. S. V. Benet, indorsed proceedings, concurring in recommendations of the Board, but in carrying out the changes, alterations, and additions recommended, suggested "that the large quantity of stores on hand

of old patterns be utilized and the changes, etc., be made as rapidly as a due regard to economy will permit."

On May 15, 1874, Gen. W. T. Sherman indorsed that he "felt hardly competent to pass judgment on the matter of cavalry equipment, and would be governed by the opinions of the cavalry officers who serve on the plains and have abundant experience. The present stock on hand could be exhausted gradually, leaving the new equipment to accumulate in store, ready for emergency, or for use after the present supply is exhausted."

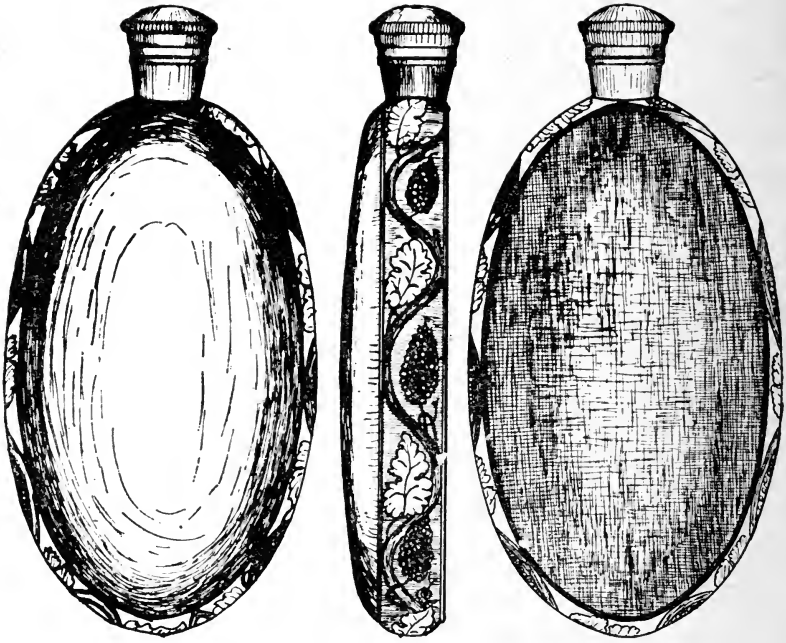
On May 20, 1874, the Secretary of War, through H. T. Crosby, chief clerk, concurred with the General of the Army and the Chief of Ordnance that the stores on hand of all patterns should be utilized before issue of new patterns except in regard to horse shoes."

The Chief of Ordnance, U. S. Army, in his annual report for the fiscal year ended June 30, 1894, states under head of "Aluminum Equipments": "Experiments with articles of equipment made of aluminum and its alloys have been continued during the year at various posts and at the Rock Island Arsenal, and very intelligent assistance has been given to the department by manufacturers. Successful results have been obtained in the manufacture of spurs, waist-belt plates, and several minor articles; but in those cases in which, from their importance as articles of considerable weight, success was hoped for most—such as bits, cups, meat cans, picket pins and horseshoes—the desired quality of metal has not yet been obtained. A very promising canteen has been designed, but not yet tested by the department, and experiments will be continued as rapidly as possible."

Recommendation That Canteens Now Disposable Be Sold.—Citation of Statute Permitting It.—Recommendation is made, under opinion of Assistant Comptroller Mitchell, and Section 1241 of the Revised Statutes, that all canteens not in the hands of troops be sold as unsuitable for the public service.

One of the synonyms of "suitable" is "expedient." An article may be suitable as far as possibility is concerned, and not suitable because it is not expedient to transport it to the place where it might be used, or to the person who could use it.

It is thought that the present stock of old pattern canteens are not suitable for military service. It is neither wise nor economical



Metallic Canteen Flask: one face concave, opposite face convex: Submitted by the Lanz Canteen Co., Chicago, Ill. Ornamental work around edge.

to retain them in government arsenals, armories or depots. They should be sold. It is submitted that these acts justify this disposition of these obsolete articles of equipment. They are important as bearing upon the Assistant Comptroller's view:

The first is the old law of March 23, 1825, upon which section 1241, Revised Statutes is based, and which is as follows: "That the President be, and he is hereby, authorized to cause to be sold any ordnance, ammunition, or other military stores, or subsistence, or medical supplies, which upon proper inspection or survey, whenever in his opinion the sale of such unserviceable stores will be advantageous to the public service; that the inspection or survey of the unserviceable stores shall be made by an inspector general or such other officer or officers as the secretary of war may appoint for that purpose and the sales shall be made under such rules and regulations as may be prescribed by the secretary of war."

The other act is that of March 29, 1894, which provides that instead of forwarding to the accounting officers of the Treasury Department returns of public property intrusted to the possession of officers or agents, "the quartermaster general, commanding general of subsistence, and other like staff officers in any department, by, through, or under whom stores, supplies and other public property are received for distribution, or whose duty it is to receive or examine returns of such property, shall certify to the proper accounting officer of the Treasury Department for debiting on the proper account any charge against any officer or agent intrusted with public property arising from any loss, accruing by his fault to the government as to the property so intrusted to him."

The act of July 31, 1894, confines the duty of the comptroller to decisions "upon any question involving a payment" made by disbursing officers.

If Assistant Comptroller Mitchell's ruling is published officially it will make possible an arrangement whereby not only unserviceable canteens in excess of future needs of the army, but also horses, mules, wagons, or other army material, not first class, hardly worth reshipping, can be sold as damaged or unsuitable for the public service, after proper inspection or survey, and when the sale of such will be advantageous to the public interests.

It is submitted that the sale of all canteens now in store in government arsenals, armories or depots, of the 1874 pattern, or 1878 or later pattern, will be advantageous to the public service because the presumption is that the appropriation for the purchase and man-

ufacture or fabrication, of equipments for infantry, and accouterments for cavalry, will be adequate to provide new model canteens.

It is understood that the army appropriation bill, second series, 56th Congress, carries with it for repairing and preserving ordnance, $75,000; for purchase and manufacture, to fill requisitions of troops, $500,000; for infantry, cavalry, and artillery equipments, $750,000.

The Chief of Ordnance, U. S. Army, is quoted as follows: "The ordnance depot at Manila is now supplying an army of nearly 70,000 men, scattered about among the islands, and yet there is but one officer available for duty at this post in addition to the chief ordnance officer whose time is fully occupied with the duties of general administration.

The improvement of material being under way at all times, technical officers must at all times be in touch with it, not only in the hands of troops, but also with the vast accumulations in reserve. The relations of the department to the line of the army should be close and intimate in order that the experience of the troops shall be available for the instruction and guidance of the department, and that the wants of the combatant branch of the army may be promptly met by the supply departments.

It has been impossible of late years to spare officers for this duty, the lack of which brings wrongfully on the department the blame of responsibility for it.

The ordnance establishments are by no means adequate to produce all the material required, and a greater part of this material is procured under contract. In the last two years, at many of the establishments from which such material has been secured, there have been no inspectors, and several establishments have been looked after by one inspector. If the inspection be not thorough, inferior material is likely to come into the service, with the resulting criticism of the Ordnance Department, and what is worse, a possible failure of the material at an important juncture."

Proceedings of Board of Officers to Examine and Test Canteens, at Rock Island, (Ill.) Arsenal, Aug. 22 to Sept. 15, 1900.

Between August 22 and September 5, 1900, nine or ten tests of two Regulation and two Lanz Canteens were made at Rock Island Arsenal by a board of three Officers of the Ordnance Department, pursuant to orders from the Chief of Ordnance and detail by the Commanding Officer of the Arsenal.

Exhibit "A" of the proceedings of the Board is as follows:

Date.	Manner of making Experiment.	Hours Exposed. A.M. P.M.	TEMPERATURE OF Air. Min. Deg.	Air. Max. Deg.	Water when put in Canteen. Deg.	Water in Canteen at expiration of time. U. S. No. 1. Deg.	U. S. No. 2. Deg.	Lanz No. 3. Deg.	Lanz No. 4. Deg.
Aug. 22	Covers dry; expos'd on window sill, in sun	9 to 2	86	96	66	102	103	98	101
Aug. 23	All except U.S. No. 1 had felt wet, with canvas covers dry. U.S.No. 1 and felt wet. On window sil, in sun	9 to 2	91½	102	66	88	88	90	92
Aug. 24	Same as in previous experiment except hung over boilers in boiler room	9 to 2.30		100½	66	84	84	85½	84
Aug. 25	Same as on Aug. 23 except hung in sun with free circulation of air	9 to 3	80	90	66	78	78	78	79
Aug. 27	Both felt and canvas covers thoroughly wet and expos'd as on Aug. 25	9 to 3	78	84	66	76	76	76	75½
Aug. 31	Same as preceeding. A third U. S. canteen was hung up dry and had a temperature of 96 deg. at end of exprmt	10 to 3	81	92	75	80½	82	82½	81½
Sept. 1	Under glass, with free access of air	10 to 2	81	92	56 (iced)	103½	100	99½	100
Sept. 4	Under glass, same as preceding experiment	10 to 2	71	99	74	87	92	95½	90
Sept. 5	Same as preceding experiment	10 to 3	91	110	75	94	93½	94	93

The Weights of Canteens, their Contents, etc., were as follows:

	U. S. No. 1.	U. S. No. 2.	Lanz No. 3.	Lanz No. 4.
	ozs.	ozs.	ozs.	ozs.
Empty and cover dry	$13\frac{1}{16}$	$13\frac{2}{16}$	$23\frac{10}{16}$	$18\frac{6}{16}$
Full of water, cover dry	$59\frac{4}{16}$	$59\frac{6}{16}$	$64\frac{6}{16}$	$50\frac{10}{16}$
Cover saturated with water, Canteen full	$65\frac{4}{16}$	$65\frac{6}{16}$	$80\frac{6}{16}$	68
Weight of water in Canteen	$43\frac{3}{16}$	$46\frac{4}{16}$	$40\frac{12}{16}$	$40\frac{4}{16}$
Weight of water absorbed by cover	6	6	16	$9\frac{6}{16}$

Two tests were concluded in four hours.

Two experiments occupied five hours each.

One test consumed five and one-half hours.

Two of the tests were each of six hours' duration.

These tests do not appear to have been made in accordance with the printed conditions upon which the claims of the Lanz Canteen are based and stated to be requisite in order to demonstrate those claims.

This statement particularly applies to the length of time claimed by that Company as requisite—in an environment or temperature above blood heat—in which to prove the merits of the Lanz Canteen and general superiority of the device.—See Claim IX.

It appears that the Board followed the methods outlined by Mr. Lanz in his letter and circular, August, 1900, describing his canteen and the experiments made by the inventor with the U. S. and his own canteens.

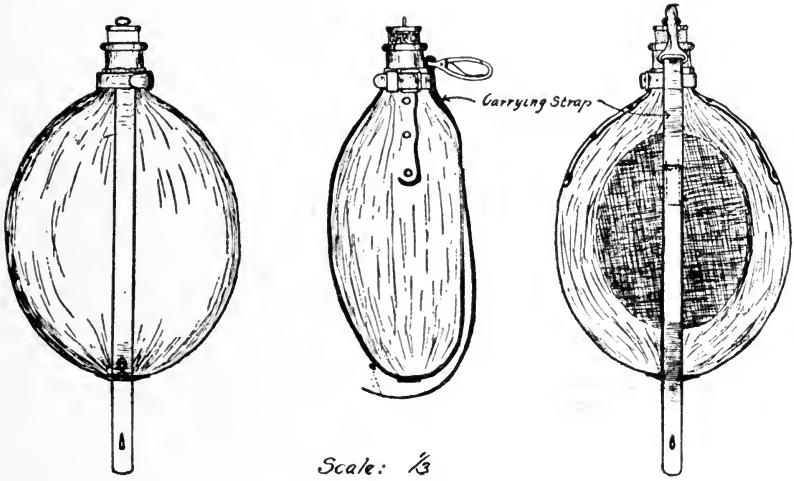
The experiments of the Board were conducted, the commanding officer states, with care and fairness, and he agreed with its conclusions.

Except in passing judgment on the flattened side of the flask, the opinion as to the advantage of the removable cover and its serviceableness, the conclusions of the Ordnance Board were based upon the results of the nine or ten tests quoted.

These results differed materially from those of the inventor of the Lanz Canteen. Besides its conclusions upon those results, the Board was of the opinion that none of the canteens had any appreciable advantage over the others in the temperature of the water they contained. The Board found but a slight difference in the relative conductivity of the covers of the canteens; referred to the fact that the Lanz was heavier, held less water than the Regulation Canteen, and added that for a period of at least six hours the government canteen will keep water as cool as the Lanz canteen. It sustained, or conceded, Claims II, IV. and part of Claims I, III and V, also VI; also the claim, but not the conclusion, of XV, in the following finding; quotation from the proceedings and summary of theBoard, viz.: "The cover of the Lanz Canteen possesses greater absorptive powers than that of the Government Canteen, consequently it would appear that this canteen would keep water at a lower temperature for a longer period under similar conditions than the Government Canteen."

— L —

Karlsruhe, Baden, Ger. Aluminum Canteen - covered by the German method, single felt with hanging strap for Cavalry also carry strap for Infantry - attached in position. Capacity 60 oz. Troy, Weight 14 oz Avoirdupois.



Scale: ⅓

CLAIMS OF THE LANZ MANUFACTURING COMPANY REGARDING THE "LANZ CANTEEN."

183-9 Lake Street, Chicago Ill., August 8th, 1900.

1. That the Lanz Canteen will keep water cool at a low temperature, or warm liquids at a high temperature, longer than any other canteen of equal capacity.

2. That the drinkable condition of the liquids carried in the Lanz Canteen will continue for a longer period, either in cold or hot climates, than in any other Canteen of equal capacity.

3. That its method of retarded evaporation secures palatable drinking water in either tropical or arctic regions for a longer time than the Regulation Canteen now used by the U. S. A.

4. That the felt will remain moist for a number of hours longer than the inner cover of felt used on the Regulation Canteen; hence the water remains cool for many hours longer in the Lanz Canteen than the same amount of water similarly exposed to a high temperature in the Regulation Canteen or any other Canteen used in military service, or submitted for experimental trial.

5. These results are accomplished, in part, by a removable, openable canvas cover, and, in part, by means of an inner cover of felt, the latter being of a quality and thickness superior to the felt used on the Regulation Canteen, and by using a greater quantity of felt as an inner cover than is used on the Regulation Canteen. These covers and methods are explained and secured by U. S. Patent No. 655,979, August 14th, 1900.

6. The results are due to the methods observed and materials with which the Lanz Canteen is covered, the latter being components of the Canteen. The absorbent properties of the Lanz felt cover, and subsequent retarded evaporation, are the agents. in hot weather, to keep the contents of the canteen flask cool.

7. In cold weather, the non-conducting properties of the components of the Canteen, the covers being dry, tend to preserve the contents of the flask from freezing.

8. The openable and removable cover possesses advantages not possessed by the Regulation Canteen; it is, with proper care, equal to it in durability. The shape of the patented metallic flask is advantageous and is superior to the Regulation Canteen, all of which entitles the Lanz Canteen to practical trial by troops actually in the field, or in campaign, with a view to its adoption by the United States for use in the military service.

9. Particular stress is laid upon the fact that the merits of the Lanz Canteen are not made so apparent by a short open-air expos-

ure of five or six hours, or less; or by tests made under temperate, or moderate, thermometric conditions—as by comparisons made after an exposure of at least eight (8) hours under thermal conditions ranging above blood heat, 96° F., or below the freezing point, 32° F.

10. As a Canteen is always worn by every combatant soldier when in the field, or campaign, as an essential article of personal equipment, but only occasionally worn when troops are in garrison, it is preferred that all tests of Canteens should be made by officers actually on duty with troops in the field, or campaign, and not by officers whose duties confine them to arsenal, or garrison, or depot duty.

11. In hot weather, that is, when the open air temperature is above blood heat, 96° F., the felt covering must be saturated, or moistened, in order to demonstrate the merit of the Lanz method as opposed to the Regulation method of covering the metallic flask.

12. As an important distinction between the Lanz and the Regulation Canteen covers is the difference in the material, and the amount of material, with which they are covered, it is essential that the fastenings of the outer cover of the Lanz be drawn up tight, after the Canteen has been immersed, so as to permit air from gaining access, and the process of evaporation thus retarded or interfered with.

13. Only in moderate weather and in winter weather should the felt be left dry. In hot weather the felt must be kept moist. To effect this last named requisite, the canvas cover must be slipped off entirely, or the lacing or fastenings of the canvas loosened.

14. The facility with which the Lanz openable cover can be removed is a decided advantage over the outer cover of the Regulation Canteen, because the latter is tightly sewn up around its entire circumference, hence the service Canteen may be immersed in water without properly effecting saturation of the inner cover.

15. As the inner cover of the Lanz Canteen possesses greater absorptive powers than the Government Canteen, it will keep water at a lower temperature for a longer time under similar circumstances than the Government Canteen, hence possesses merits sufficient to warrant a trial in the military service with a view to its adoption in lieu of the Regulation Canteen.

16. In cold, or cool, weather, the felt, of course, is not moistened, in which condition it will maintain the heat of the fluid contents for a longer period than the Regulation Canteen, and so lessen the danger of freezing.

17. The Lanz Manufacturing Company can furnish Canteens

and their components of any specified weight or indicated fluid capacity, whether less than, equal to, or greater than, the Government Canteen, utilizing for the purpose any metal or material, or of any prescribed pattern or model desired, retaining, of course, its non-conducting inner fabric or textile cover, and also retaining the removable, openable, patented outer cover and fastening methods.

18. The advantages of the Lanz Canteen are more than appreciated by soldiers when in the field or during a campaign in a tropical region, or on a hot day, because conducive to comfort, effectiveness and health.

19. The Lanz Manufacturing Company claims to be able to produce a canteen flask, retinned after the plate has been stamped into shape, and which may have a piece of zinc soldered to the inside, or, perhaps, a zinc nozzle, the durability of which retinned flask will largely exceed that of the Regulation Canteen, and which will prevent oxidation for at least four times as long as the Regulation Canteen.

Commendations and recommendations are exhibited by the Company from the following named Army officers: Col. J. M. J. Sanno, 18th Infantry; Maj. P. H. Ray, 8th Infantry; Maj. S. L. Woodward, 1st Cavalry; Assistant Surgeon A. E. Bradley, Medical Dept.; Assistant Surgeon S. M. Waterhouse, Medical Dept.; Capt. Geo. W. Goode, 1st Cavalry; 1st Lieut. W. M. Whitman, 1st Cavalry; 2d Lieut. H. C. Smither, 1st Cavalry; 2d Lieut. F. W. Healy, 8th Infantry; 2d Lieut. A. V. L. R. de Beaumont, 8th Infantry; 2d Lieut L. A. I. Chapman, 1st Cavalry; Ordnance Sergeant Alexander Pillow, U. S. A.; Sergeant J. K. Miller, 3d Infantry. Also from several business and manufacturing firms employing laborers, artificers, etc. Likewise from tourists, bicyclists, sportsmen, officers of U. S. Volunteers, National Guardsmen, etc.

The Company supplements its published list of testimonials by two temperature tests, one a hot weather test made on the roof of theLanz factory; the other a cold weather open air test. In each trial a U. S. Army canteen is also said to have been used in comparison.

Naturally, the results as published, were highly favorable to the Lanz Canteen. The first test covered a period of seven hours.

Sanitation and Hygiene as Applied to Canteens.

The use of polluted water is a factor dangerous to health and accounts for the prevalence of disease in localities where other sanitary conditions are beyond reproach. It is the part of wisdom to remove

danger of possible contamination by the use of a canteen which can be completely emptied, drained and even sterilized.

By inserting the little finger in the mouth-piece of the present regulation tin flask canteen, there can be felt enough abiding places for pathogenic germs and micro-organisms to make the use of the canteen a dangerous factor after polluted water has once entered the flask.

In the regulation canteen, the mouth-piece is either inserted or applied like a spout. In either case, it is a separate piece of sheet tin, soldered on. The projections and rough edges become nesting places for waste matter, and breeding places for things dangerous to health, even after pure or sterilized water has been deposited in it.

Soldiers have not access to germicidal supplies, nor can the insides of canteens be inspected in the way that health officers inspect milk cans, pans, dairies, and creameries. The present regulation canteen can carry typhoid. As bacteriological examinations cannot be made of canteens where the latter are daily carried as a portion of the field equipment,—it would be wise to abandon the present regulation canteen and adopt in lieu one differing in material, construction and shape.

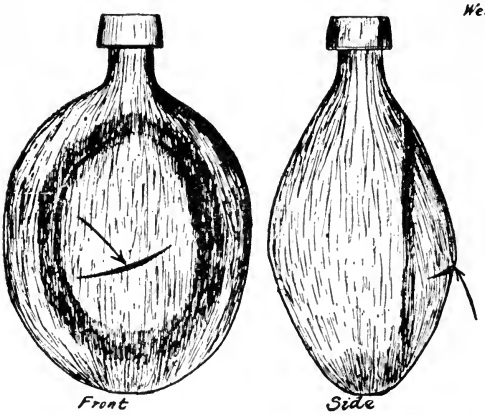
Comparison of the Armies in China—Narrative by an American War Correspondent About Canteens, Other Personal Equipments of a Soldier, and Army Water Supply.

The dweller in towns can have no conception of what the lack of a plentiful supply of good water is. Water, to them, like air, is cheap and common. During the interval between our Civil War and the Spanish-American War, the only soldiers of our army who appreciated the value of water, and of a good canteen, were such of the military establishment as had service in arid regions in hot weather, and hence had been compelled to rely upon the article of personal equipment named.

Thomas F. Millard, writes from China: "Examine military medical statistics and you will find that half the ills an army is heir to are directly traceable to the use of bad water. I sometimes wonder whether we Americans shall ever learn some things, and generally sadly reach the conclusion that we never shall. In this problem of army water supply, the Japanese stand for *efficiency*—the Americans for *deficiency*, with other nations struggling along somewhere between. The water in North China is so bad that resident Euro-

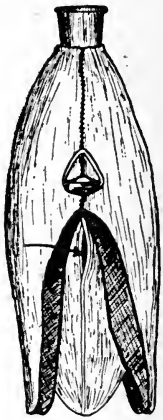
—D—

Karlsruhe, Baden, Germany. Aluminum Flask; no cover; capacity, 25 oz., weight 5 oz.



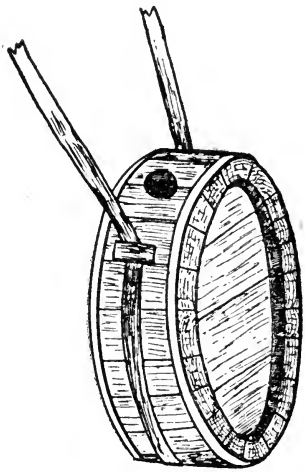
—A—

U.S. Army Regulation Service Canteen, Ordnance Pattern, double cover, felt and canvas. Capacity 43 fluid ounces. Weight 14 oz. avoirdupois

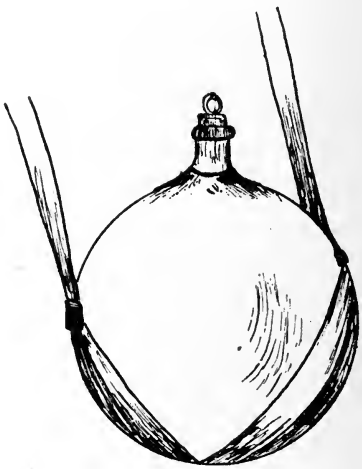


Scale: 1/2

Arrows show where leakage began



Type of wooden canteen used in the United States Army pattern of 1812, and during our second war with England. (From a tracing furnished by the Quartermaster General, U.S.A.)



Tracing furnished by the Quartermaster General U.S.A. of the type of tin flask canteen covered with cloth used in the United States Army 1848-1861.

peans will not drink it until it has been boiled and filtered. The fact was well known before a foreign soldier set foot at Taku. It was also realized that there was danger of wells being poisoned by the Chinese; while to use, unpurified, the filth-laden waters of the canals and rivers was to invite an epidemic among the troops. The Japanese came fully provided with portable filters for use in the field. They were the only troops who possessed these necessary utensils, and they spared the men much. They also had in common with all the allies, except the Americans, provisions for supplying the troops with water while on the march or in action. When the Fifth Army Corps, United States Army, made the glorious, but in many ways disastrous, campaign against Santiago, June-August, 1898, we paid a price for ignorance which might have taught us a wholesome lesson. One of the deficiencies, and one commented on by all the foreign military attaches who accompanied the army, was the utter lack of water supply except the small quantity the men could carry in their canteens. There was no reserve. When the water bottles ran dry the men would drop out of the line of march to replenish them. In so profusely watered a country as Cuba that was not difficult, owing to the proximity of the Seco, the Aguadores, and the San Juan. Water could always be found near by, or secured while crossing a stream, but the custom is always retarding of progress and detrimental to discipline. But even where water is most plentiful, the practice throws the door wide open to the insidious disease germ. Here in China where water is fairly plentiful, but marvelously filthy, to provide no reserve water supply for troops on the march, is to condemn all of them to needless suffering and many of them to death. Two years of almost constant campaigning in the Philippines, coupled with the experiences in Cuba, have taught Americans nothing. Our troops turned up in China with their canteens, and no more. I believe one or two filters, suitable for camp or barrack use, and too cumbersome for ready transport, have finally arrived. But they could not, had they been here in time, have been utilized on the march along the sluggish Pei-ho to Peking—the mother of thousands of ditches, all equally filled with a contaminated, yellow, slimy fluid, spreading out over the country like a web of an immense water-spider, licking up the filth of countless villages, and feeding, or draining, as the case may be, their cousins—the cesspools. The men suffered terribly. Through the middle of the day the heat was intense. Millions, billions, trillions, of flies, buzzed and bit. For miles the road ran through millet fields. The grain stands from ten to twelve feet high, completely shutting off any breeze

which might possibly be stirring. At every step the men and animals sank a foot into the dust, which, ground into impalpable powder by the passage of thousands of vehicles, hung in a stifling cloud over the line of march, filling throats, eyes, lungs, and nostrils. The sun struck a man between the shoulders and burned them like a red-hot plaster. Rivulets of perspiration trickled and dripped, converting faces into river charts of China, half mud and half water, and causing eyelids to gum up and smart painfully. Canteens were emptied quickly during the six successive days march after the battle of Yang Tsun to Peking, and, notwithstanding positive orders to the contrary, were refilled out of wells on the putrid Pei-ho.

Staggering along under their blanket-rolls and full marching equipment, what wonder that the troops could march but a short distance without resting, and that the total of a day's effort would be but about eight miles. At night, the mosquitos relieved the flies as agents of unrest, swarming in dense clouds about the camps. Within a week after their arrival in Peking, over one-third of the American force was in the hospital. This was about the average throughout the army,—Germans, Russians (including Cossacks), British (including Australians, English, Sikhs, Ragputs, Ghurkos, and Chinese), Americans, French (including Tonquin and Cochin China native regiments), Japanese, Austrians, and Italians, to say nothing of the "Boxers" and Imperial Chinese troops.

If ever troops needed water reserve supply, for urgency as well as sanitary reasons, it was on that march. The Japanese, Russians, Germans, French, and British, all were provided in some way. The Japanese drank only aerated water prepared regularly by the field filters, the water cart moving with the column and permitting the replenishing of the canteens at any time without hindering the march or scattering the troops. For the Japanese officers and wounded, there was an ample supply of bottled mineral water. The British, Germans, and Russians, all had a reserve supply, either in carts or carried in skins on mules. Only the Americans were utterly destitute. An average of one-third of the force was always away from the column on a hunt for drinking water. At nightfall, when the camps were pitched, they would have, perhaps, to tramp long distances to obtain enough water for cooking purposes, while all the other allies had theirs ready to hand, simply, it was some one's business to attend to it and see that proper facilities were provided. Truly, 'tis a lop-sided commissary service which supplies an army with solid food—and woe to it if it fail—but makes no provision whatever for water.

While both are indispensable, water is far more of an urgent necessity to troops than is other food. Frequently a few drops mean whether a soldier will drop or continue to march, and the first cry of a wounded man is for water. The advisability of supplying troops with water, even while in action, has long been recognized, and, notwithstanding the difficulty, has been successfully accomplished.

In this war I have, for the first time, seen the "bhisti," whom Rudyard Kipling has immortalized as "Gunga Din" at work. He has a brother now in the Jap water coolie, whose duty is to supply water to troops in action, and succor the wounded on the field. Some day, perhaps, Uncle Sam may awake to appreciation of the necessity of some needed reforms in his army and take a leaf out of the Mikado's book. Three days after the allied forces entered Peking, over eight hundred Americans or one-third of the total force under General Chaffee, were in the hospital. The percentage of Japanese troops unfit for duty at the same time was less than five. Yet they had done more work during the campaign than had the Americans.

We seem, for some reason, always to be lacking adequate transport. Some of the powers are just as badly off as the United States in this matter of proper transport, but some are immeasurably superior. The Japanese and British-Indian contingents are the best. They have not only developed the light vehicle and small package system to a high state of excellence, but they have found another accelerator in the use of a large number of camp followers. In a British or Japanese regiment the number of camp followers almost equals the number of men bearing arms.

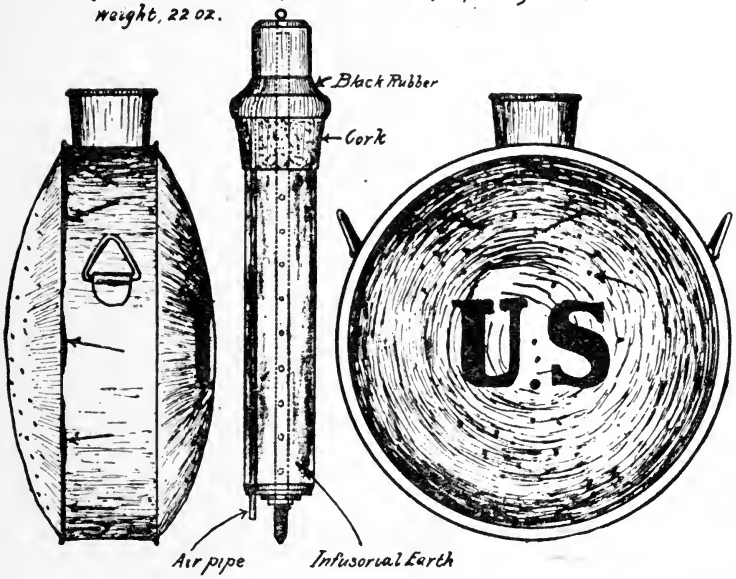
These auxiliaries are really servants of the troops. They relieve the fighting men of all superfluous baggage on the march and do the camp labor when the column halts. The Japanese or British-Indian soldier carries nothing while marching except his rifle, ammunition, and water bottle. Not only can he move faster and with less fatigue, but he is prepared to go into battle at an instant's notice. The American, German, or French, soldier, if suddenly attacked or brought into action, has to cast aside his heavy, bulky kit. These are frequently stolen before the men return to secure them, if they ever do. Witness the denuding of our troops by the straggling bands of Cubans during the Santiago campaign. Then, suppose the troops advance several miles in the course of an engagement, which frequently happens; they must either abandon their personal equipment (less rifle, ammunition, canteen, cup, and intrenching tool) entirely, or return for it, even if they can locate and find it intact, thus covering a distance three times when once should

have sufficed. Such matters as these often decide the success or failure of a campaign. It is a humiliating fact that in nearly every march of any distance which the allies have made in China, the Americans held the column back because they were unable to keep up. A remark of General Dorward is recalled as he watched the little detachment of Americans toil painfully and slowly through the mud on the march to Tulin. The General who commanded the expeditionary force, had ridden back with his staff to see what was keeping the Yankees back. "Fine fellows," he said as he gazed at them, "Fine fellows. Splendid physiques. Pity they load them down so they can't march."

It was a matter of comment during the march to Peking that the Americans had more men drop out from heat prostration, and required to rest oftener, than the troops of any other nation. Frequently one-fourth the American force, with those who went down and those who stopped to attend them, would be out. The climate cannot account for this. It is very similar to that of the greater part of the United States. The troops were not "green." They were veterans, just from months of active service in the Philippines and Cuba. It was not inferiority of physique. The Americans are the strongest men out here. What then, was the reason? The men were required to do too much. In marching, they carried three times the weight imposed upon Japanese, British, or Russian troops. Then, a dozen times during a day they were compelled to make detours to replenish their canteens. While, the march having ended, the Japs or British soldiers were taking things easy, while their camp followers pitched the tents, lighted the fire, cooked the food, and prepared the beds, the weary American doing all these things for himself. What wonder that he frequently, from sheer exhaustion, went supperless to bed, and slept unsheltered rather than undergo the labor of pitching his tent, to become the next day a ready victim to heat and dysentery? The camp auxiliary certainly pays for his keep. In spite of his many handicaps, the American soldier has held his own. He has numerous weaknesses, but fear of the enemy is not, fortunately for the security of the Republic, one of them. I heard foreign officers criticise freely his military manners, organization and equipment,—but never his fighting qualities, once his burden of antiquated methods is cast aside and he faces the foe on the fighting line. There he is as he always was, and let us hope, always will be. In all the criticism one hears there is an undercurrent of respect. I never see him in a fight but I feel, with absolute certainty, that the American

— C —

Dubuque Stamping & Enamel Co. Canteen,
(with Parker Filter) no cover; capacity 50 oz.,
weight, 22 oz.



Scale: 1/2

Arrows show where Enamel broke off

Arrows show where leakage began

soldier will ever give a good account of himself if not asked to do more than should be asked of any man. Other elements being approximately equal, the stoutest heart and steadiest nerve will win in the most battles. In these qualities, Uncle Sam's boys are second to none. "They have done their share," is the verdict of people in China, who have been here through it all. The lessons of this war have chiefly held to the prosaic lines of organization, supply, and equipment, and on matters such as these they have shed a brilliant light for those who care to learn."

How the Carreta, or Water Cart, Used at Headquarters, First Division, Fifth Army Corps, 1st July-10th August, 1898, at Santiago de Cuba, Was Obtained.

During the afternoon of Friday, 1st July, 1898, after the commander of the First Division, Fifth Army Carps,—General J. Ford Kent,—accompanied by his aide, the late Major George S. Cartwright, and the Division Inspector, mounted, reached the crest of San Juan hill, where we had been preceded by General H. S. Hawkins, and the 6th and 16th United States Infantry, there was a lull in the firing of the retreating Spaniards. This gave opportunity for a brief inspection of the grounds. A carreta, a dead mule, and some empty water casks, were noted on the western slope. A carreta, is a cart with two wheels, fitted to be drawn by one animal. This particular one had been used by the Spaniards to haul water to Fort San Juan. A sketch of the carreta, or water cart accompanies this report. The original of the sketch was made by Mr. Adolfo Carlos Munoz,—volunteer aide-de-camp on General Kent's staff,—wounded by a shrapnel bullet just above the right ear, p. m. of the following day, died 11th November, 1899.

After a portion of the 24th United States Infantry gained the summit on the date first mentioned, the Inspector got a colored sergeant, name unknown, and two privates same regiment, to assist in making a break down the slope for the carreta and the barrels. We succeeded in hauling the outfit up over the crest, and down to where the Division Commander's hammock was. There it remained in charge of Second Lieutenant Fred L. Munson, commanding the division headquarters detachment guard, until August 10th,—date of departure from Santiago de Cuba, for Montauk, L. I. The carreta saved many a weary trip to the San Juan river for a canteen full of water.

OBSERVATIONS ON THE PEKIN RELIEF EXPEDITION.

By Captain William Crozier, Ordnance Department, U. S. A.

The Chief Ordnance Officer, General Chaffee's Staff, states as follows: From the time of the arrival of the first American troops at Tien Tsin,—9th Infantry,—plenty was the order of the day. Ginger ale and bottled water were in abundance. The fare was less generous on the march to Pekin.

No provision was made for supplying the United States troops with water on the march, other than the canteen which each man carried. Other troops were better off in this respect. The British Indians carried water in skins on pack mules, and some had barrels upon carts. But there are wells in all the Chinese villages, and these, along the line of march, were not more than a mile and a half apart; and, with the column properly halted, it is as easy to fill canteens from a stationary well as from a stationary cart or mule. The water in the wells was always cool, and, though seldom perfectly clear, it was never revoltingly turgid, as was that of the rivers and canals; it was drank freely by all the troops of the expedition. No other troops made such a time about water as the Americans, who had orders to drink none without boiling it, and had special utensils provided for the purpose. These orders could not be enforced, however, as thirsty soldiers will not wait even when arrived in camp, for water to boil and cool. Portable filters were provided and were used in the hospital service, one also I observed in the light battery, and one was in the headquarters mess. The characteristic ailment of North China, however, seems to come independently of the water; it attacks nearly all Europeans and Americans during their first summer, not sparing even those who drink nothing but imported waters. With careful inquiry, I was unable to find a medical man who could assign a satisfactory reason, other than it was "in the air."

I have neither heard nor read any criticisms of the operations of the Subsistence Department, other than as these were affected by lack of transportation, which suggests an inquiry as to the character and quantity of the latter. The Americans had thirteen four-mule army wagons and one pack train of forty freight mules, besides two or three ambulances and a Dougherty wagon. This supply was intended to take care of two regiments of infantry, a battalion of marines, a light battery, and the headquarters. The four-mule wagon is considered to be distinctly superior to the means of transportation of supplies employed by the British, Japanese, Russians, or French. * * * The American train had one man

to four mules, all the loaded animals being driven in a bunch with a bell-mare leading. Here also was economy of numbers, although perhaps the Japanese provision of a man to each animal was a necessity, as their ponies are all stallions, and their train at a halt was a bedlam of flying heels and wild snorts, it was more dangerous to pass than a Chinese outpost. A large proportion of the Japanese transportation consisted of pack animals; the British Indians had nothing else; the inferiority in economy, when contrasted with the American system, is striking, when it is noted that it requires the same number of mules to carry 1,000 pounds on packs as will haul 3,000 pounds in our army-wagon. The American pack train carried ammunition only, for which purpose it could not have been replaced, as it afforded the only means of maintaining a first reserve supply in constant readiness for immediate distribution to the firing line. The pack saddles of the different nationalities were, in their effect on the animals, of about equal merit. Occasional sore backs were noticed in all the trains, but the American required the most skillful packer.

* * * * * * *

Within three days after the arrival at Pekin, bottled waters and fancy groceries began to make their appearance in the American commissary and within a week there was abundance of these for all.

If a sufficient number of four-mule wagons, the most rapid and economical transportation yet devised for countries in which they can go at all,—and with a very little help they can do marvels in the way of trail covering,—be supplied to carry all the men's baggage, except their arms and canteens, and, in addition, a sufficient number of armed men to act as train guards, riding either in the seats with the drivers or on others provided, these men would be sufficiently fresh to do the loading and other extra work, and the whole organization would be made more economical and serviceable than one provided with coolie corps.

FURTHER OPEN AIR TESTS MADE OF CANTEENS

INTENDED FOR USE IN MILITARY SERVICE, MADE AT HEADQUARTERS DEPARTMENT OF DAKOTA, ST. PAUL, MINNESOTA.

(For description of various canteens tested see pp. 57-61 this report; also further description given below.)

Specifications, etc., of Canteen "AA".—Canteen "AA" is the regulation service pattern canteen, manufactured at Rock Island Arsenal, 1900, and issued to me direct from there. It has double cover—Petersham felt inner, and dyed duck, or canvas, outer cover.

Capacity 44 fluid ounces, 45 and 2-4 ozs. avoirdupois. Weight, empty, covers on and dry, avoirdupois, 12 and ¾ ounces. Weight, filled, covers on and dry, avoirdupois, 58 and ¼ ounces. Weight, filled, covers on, after ten minutes' immersion, avoirdupois, 63 and 2-4 ounces. Weight of the tin canteen flask, empty, no covers on, avoirdupois, 9 and 2-4 ounces.

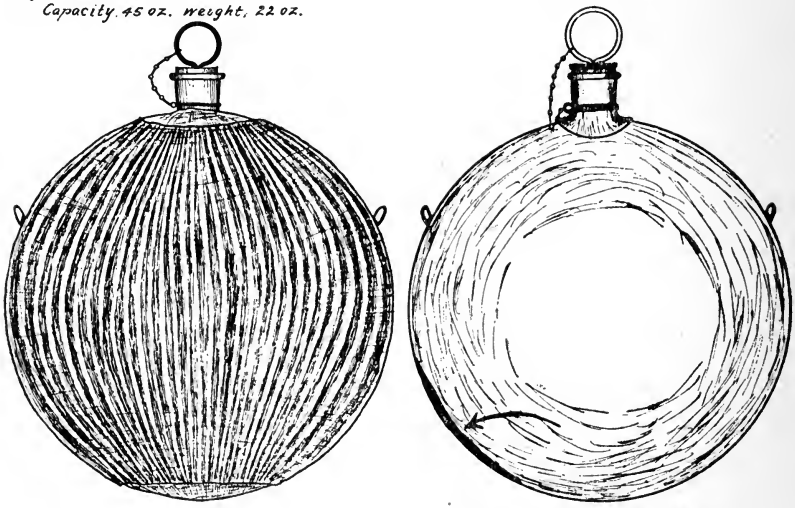
This canteen was sent for and used by me in order to have a standard of comparison, and because of variations noted in other canteens issued to the First Cavalry, Eighth Infantry, and other organizations from which I received them, termed "U. S. Army Regulation Service Canteen, Ordnance Pattern," or "U. S. Army Regulation Service Tin Flask, Ordnance Pattern", etc. In all tests made after Test No. 68, all three of these service canteens, or flasks, were used. Tests were conducted as described on pp. 43-4, this monograph, and by the same person, using the same thermometers.

Specifications of Canteen "BB".—Canteen "BB" is a combination canteen and filter. Canteen is of the regulation tin flask type, double cover—regulation felt or Petersham inner, and dyed duck or canvas outer. Made at Rock Island Arsenal, October, 1898, with a specially wide mouth to accommodate the Mrs. Caroline Parker Filter. Capacity, filter in, 40 fluid ounces, 42 ounces avoirdupois; filter out, fluid 45 ounces, avoirdupois, 46 ounces. Weight, filled, covers on and dry, filter in, 59 ounces avoirdupois. Ditto, after ten minutes' immersion, 64 ounces avoirdupois. Weight of the tin flask, empty, no cover, filter out, 9 and ¾ ounces avoirdupois. Weight of filter, including soft rubber top, 3 and ¼ ounces avoirdupois. Weight of duck, or canvas, cover, dry, 1 and 2-4 ounces. Weight of same after ten minutes' immersion, 3 and ¼ ounces avoirudpois. Weight of water absorbed by the canvas cover, 1 and 2-4 ounces. Weight of the Petersham felt, or inner cover, dry, 1 and 2-4 ounces. Weight of same after ten minutes' immersion, 7 and 2-4 ounces avoirdupois. Weight of water absorbed by the inner cover, 6 ounces avoirdupois. Weight of the canteen "BB", empty, covers on and dry, filter out, 12 and ¾ ounces avoirdupois. Weight of the canteen, empty, covers on and dry, filter in, 16 ounces avoirdupois.

Specifications of Canteen "CC".—The canteen purchased by the United States for trial, in December, 1898, or October, 1898, from the Dubuque Stamping and Enamel Company, has been described, and the objections to enameled metal as a material for canteen flasks dwelt upon, in previous pages of this monograph. In the test tables it is termed canteen "C".

— B —

U. S. Army Regulation Service Canteen, Ordnance Pattern, double cover, felt and canvas, but having, also, a woolen stocking leg drawn over it.
Capacity 45 oz. weight, 22 oz.



Arrow shows where leakage began.

Scale: ½

Canteen "CC" is an enameled metal canteen flask bought by the U. S. from the Dubuque Stamping & Enamel Company. Its construction, also its material, is in general identical with that of canteen "C",—Differing in these details: It is covered and its capacity is less. Its side pieces have wire triangles.

Canteen "CC" has a double cover of the same materials, apparently as are used in Regulation canteen "A" or "AA." It lacks the filter with which canteen "C" is provided, and the mouthpiece, or neck, is different. (See blue print of "C," and of "CC", also sketch of "C", accompanying this report.) The construction of the wire side triangles of "CC" is similar in material and in shape to the present regulation canteen. The side loops are not,—they being made of enameled metal ware.

Flask "CC" is encircled by a band, 42 in. by 1 in., of same material as the Petersham felt. It is provided with 2-4 of an ounce more of this absorbent material than the regulation canteen has. The side band plain iron wire triangles of this canteen are engaged in ears of enameled metal, each of which is fastened to the side band by means of two rivets. The mouthpiece, or nozzle, is also a separate piece of enameled metal, the overlapping edges of which are held together by means of two rivets. Apart from the triangles, rivets, neck-chain, neck-band, chain, cork and its attachments, six pieces of enameled metal are employed in the construction of the canteen flask.

Capacity, in fluid ounces, 43. Avoirdupois ounces, 44 and ¾.

Weight, empty, covers on and dry, avoirdupois, 20 ounces.

Weight, filled, covers on, after ten minutes' immersion, 74 ounces.

Weight, filled, covers on and dry, avoirdupois, 64 and ¾ ounces.

Weight of the empty enameled flask, no covers on, avoirdupois, 16 and ¼ ounces.

Weight of the duck or canvas cover, dry, avoirdupois, 1 and ¾ ounces.

Weight of the duck or canvas cover after ten (10) minutes' immersion, avoirdupois, 2 and ¾ ounces.

Weight of the water absorbed by the canvas cover, avoirdupois, 1 ounce.

Weight of the Petersham felt, or inner cover, including the band, dry, avoirdupois, 2 ounces.

Weight of the Petersham felt or inner cover, including band, after ten minutes' immersion, avoirdupois, 10 and 2-4 ounces.

Weight of the water absorbed by the Petersham felt, or inner cover, including the band, avoirdupois, 8 and ¾ ounces.

TEST No. 69.

Hour.	Outside T.	Temperature of Water in Canteens. Each canteen was full. Covers Dry. All of the canteens were suspended from a trestle, so that free circulation obtained.																			
		A	A-I	A	A	B	B	B	C	C	E	G	H	I	L	Q	R	S	T	U	V	W	X
8.00 am	+48	170	170	170	170	170	170	170	170	170	170	170	170	170	170	170	170	170	170	170	170	170	170
9.00 "	50	120	106	130	144	126	138	98	152	158	154	132	152	150	144	146	150	122	96	92			
10.00 "	52	94	74	104	122	100	112	72	130	144	132	110	132	126	126	126	130	96	68	*66			
11.00 "	56	80	66	90	108	86	96	64	118	136	118	94	118	114	116	112	114	82	62	60			
12.00m.	58	72	62	80	94	76	84	62	106	122	106	86	106	104	102	102	102	74	60	58			
1.00 pm	60	66	62	72	84	70	76	62	96	112	94	78	98	94	92	92	92	70	60	58			
2.00 "	58	64	58	66	78	66	72	58	90	108	86	72	89	88	88	84	86	64	58	56			
3.00 "	58	62	58	66	72	62	68	58	84	100	80	68	84	82	80	80	80	62	58	58			
4.00 "	58	60	58	62	70	60	64	58	78	94	74	64	80	74	76	74	74	60	58	58			
5.00 "	58	58	58	62	66	60	62	58	74	92	72	62	74	72	72	70	72	58	58	58			

*Leaky.—Leakage occurred in Canteen "X" at the point where the stirrup shaped loops were clamped to the sides of the flask by means of four rivets. The Parker filter in Canteen "BB" was found to be broken, having separated from the soft rubber top. Breakage thought to be occasioned by leaving the flask, filter in, against steam radiator.

TEST No. 70.

Hour.	Outside Temp.	Temperature of Water in Canteens. Conditions same as in preceding Test. All Covers Dry.																			
		A	A-I	A	A	B	BB	C	C	E	G	H	I	L	Q	R	S	T	U	V	W	X
7.45 a.m.	+46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46
8.45 "	48	48	48	48	48	48	48	48	48	48	48	46	50	50	48	48	48	48	52	48	46	
9.45 "	50	50	50	50	50	48	48	50	48	48	48	52	52	50	50	48	48	54	50	*48		
10.45 "	54	54	52	52	52	50	50	50	48	50	50	54	52	52	50	48	50	56	50	48		
11.45 "	54	54	54	54	54	50	52	52	50	50	52	56	54	52	52	50	50	58	50	50		
12.45 p.m.	58	56	54	54	54	52	54	56	50	50	54	58	56	54	54	52	52	60	54	52		
1.45 "	52	58	54	56	56	54	56	56	52	50	54	58	56	56	54	52	54	60	54	52		
2.45 "	54	56	54	54	56	54	54	54	54	52	54	58	56	54	54	52	54	58	54	54		
3.45 "	54	54	54	54	56	52	54	54	54	52	54	56	56	54	54	52	52	56	54	54		
4.45 "	54	54	54	54	54	54	54	54	52	50	54	56	56	54	54	52	52	54	54	52		

*Leaky.—Leakage in Canteen "X" as in preceding test. Temperature of "V," the Eveking, Westphalia, Canteen, rose above that of the air, and remained above that of its environments for a period of eight (8) hours. Aluminum Canteen "L," the Karlsruhe, Baden, one; also, the Lanz tin flask. Canteen "Q" rose above the atmospheric temperature.

Note should be made that none of the canteen covers were wet, or moistened.

TEST No. 71.

Open air test—in sun for six (6) hours, followed by three (3) hours in the shade. Each canteen was full. All covers dry. All of the canteens were suspended from a trestle, so that free circulation prevailed. Test made on the roof of the L, Army Building, Headquarters Department of Dakota, St. Paul, Minn.

Hour	Out-side Tem.	Temperature of Water in Canteens.																		
		A	A-I	A A	B	BB	C C	E	G	H	I	L	Q	R	S	T	U	V	W	X
a.m.																				
7.50	+58	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	*48
8.50	60	58	56	50	50	52	56	54	48	48	50	66	54	48	50	54	50	54	54	56
9.50	70	60	60	54	54	54	58	58	50	50	52	68	58	50	52	54	52	58	58	58
10.50	63	64	64	58	56	58	62	64	52	52	56	70	62	56	54	58	56	64	62	60
11.50	70	66	66	62	60	62	64	68	56	54	58	72	64	58	56	60	58	68	64	60
p.m.																				
12.50	72	70	68	64	64	64	66	70	58	56	60	74	66	62	60	60	60	70	66	64
1.50	60	70	66	66	66	66	66	70	60	58	62	74	66	64	62	62	62	70	66	64
2.50	60	66	64	64	64	64	64	64	60	58	62	70	66	62	62	62	62	66	62	62
3.50	60	64	62	62	64	62	64	62	60	58	60	68	66	62	60	60	60	64	62	62
4.50	60	62	60	62	62	62	62	60	60	58	60	66	64	62	60	60	60	62	62	60

*Leaky.

COMMENT.—Temperature of "A" – Regulation Canteen—held above that of the air during the last three hours.

Temperature of "L"—Karlsruhe, Baden, aluminum, German single felt-covered canteen—ranged and kept above that of the air during the closing eight hours of the test.

Several other canteens rose to a temperature above that of the atmosphere, and kept above it, during the three closing hours that the trestle was in the shade.

Note should be made of the fact that none of the covers were wet, or moistened, before or during this test.

TEST No. 72.

Hour.	Out-side Temp.	Temperature of Water in Canteens.																		
		All the canteens were full, covers dry, suspended from a trestle under glass (storm window—eight panes of glass, each 20x17 inches) placed nearly horizontally above the canteens in such a manner as to admit free circulation of the air. Trestle stood on roof of L of Army Building, St. Paul, Minn.																		
		A	A-I	A A	B	B B	C C	E	G	H	I	L	Q	R	S	T	U	V	W	X
a.m.																				
9.15	+60	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56
10.15	60	58	60	58	58	60	60	60	58	58	58	60	58	58	58	58	58	60	58	*60
11.15	70	62	62	60	60	60	60	62	60	58	58	62	60	60	60	58	60	62	62	62
p. m.																				
12.15	70	64	64	62	62	64	64	66	60	60	60	64	62	62	62	62	60	66	62	64
1.15	64	64	66	64	64	64	66	68	62	62	62	66	64	64	64	62	62	68	64	66
2.15	66	66	66	66	64	66	66	68	62	62	62	68	66	64	64	64	64	70	64	66

*Leaky.

TEST No. 73.

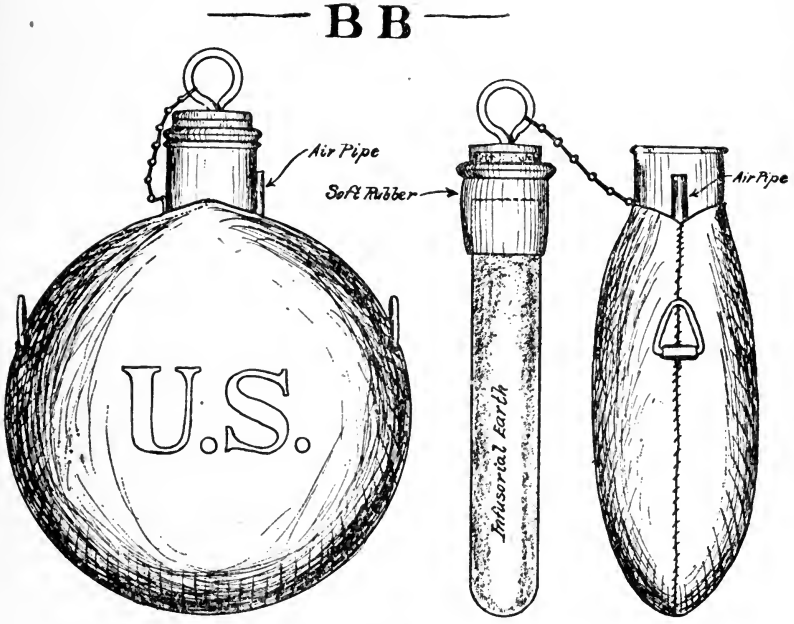
Hour	Outside Temp.	Temperature of Water in Canteens. Conditions: Under glass, same as in preceding test.																		
		A	A-1	A A	B	B B	C C	E	G	H	I	L	Q	R	S	T	U	V	W	X
a. m.																				
8.15	+50	56		56	56		56	56	56		56	56	56	56	56	56	56			
9.15	54	56		56	58		56	56	58		56	58	58	56	58	58	58			
10.15	56	56		56	58		56	56	58		56	58	58	58	58	58	58			
11.15	58	56		56	58		56	56	58		56	58	58	58	58	56	58			
p. m.																				
12.15	60	56		58	58		58	58	58		56	58	58	58	58	58	58			
1.15	60	58		58	58		58	60	58		58	60	58	58	58	58	58			
2.15	60	58		60	60		60	60	58		58	60	58	58	58	58	58			
3.15	60	58		60	60		60	60	58		58	60	60	58	58	58	58			
4.15	60	58		60	60		60	58	58		58	60	60	60	60	58	58			
5.15	58	58		58	58		58	58	58		58	60	58	60	60	58	58			

TEST No. 74.

Hour.	Outside Temp.	Temperature of Water in Canteens. Open-air test, canteens all full, covers dry, suspended from trestle, free circulation of air.																		
		A	A-1	A A	B	B B	C C	E	G	H	I	L	Q	R	S	T	U	V	W	X
a. m.																				
7.40	+52	50		50	50		50	50				50	50	50	50	50	50			
8.40	52	48		48	48		48	52				52	46	52	48	54	54			
9.40	48	48		48	48		48	50				52	46	52	50	54	54			
10.40	52	48		48	48		48	52				52	48	52	50	54	54			
11.40	54	50		50	50		50	52				52	50	52	50	54	54			
p. m.																				
12.40	56	52		52	52		52	54				54	50	52	52	54	54			
1.40	56	54		54	52		54	56				54	52	52	52	54	54			
2.40	56	54		54	54		54	56				54	52	54	54	54	54			
3.40	54	54		54	54		54	54				54	52	54	54	54	54			
4.40	54	54		54	54		54	54				54	52	54	54	54	54			

TEST No. 75.

Hour.	Outside Temperature.	Temperature of Water in Canteens. All canteens full, covers dry, suspended from trestle, under glass—same as in Test No. 72.										
		A	A A	B	C C	E	L	Q	R	S	T	U
9.30 a. m.	+62	56	56	56	56	56	56	56	56	56	56	56
10:30 "	68	60	60	60	60	62	58	58	60	60	60	58
11.30 "	66	62	62	62	60	62	58	62	60	62	60	60
12.30 p. m.	64	62	64	62	62	64	60	64	64	62	62	60
1.30 "	64	64	64	64	64	66	62	64	64	64	64	62
2.30 "	62	64	64	64	64	64	62	64	64	64	64	62



Combination canteen and filter. Canteen is the regulation tin flask and double covers. Made at Rock Island Arsenal, Oct. 1898 with a specially wide mouth to accommodate the Mrs. Caroline Parker filter, Capacity. filter in { Avoirdupois 42 oz. / Fluid oz. 40

Weight, filter in, filled, covers on and dry Avordupois 59 ounces
Weight. filter in. filled, covers on, after ten minutes immersion, Avoirdupois., 64 oz.
Weight of the tin flask, no covers, empty, filter out. 9¾ oz.

TEST No. 76.

Hour.	Outside Temperature.	Temperature of Water in Canteens. Canteens "A," "AA," "B" and "CC" immersed for sixteen (16) hours before commencing test—inside covers of canteens "L," "Q," "R," "S" and "T," also "U," saturated—outside covers dry when test commenced. A fine rain prevailed during the entire period, eight (8) hours, covered by the test.										
		A	A A	B	C C	E	L	Q	R	S	T	U
8.00 a. m	+48	46	46	46	46	46	46	46	46	46	46	46
9.00 "	48	46	46	46	46	46	48	50	50	50	48	52
10.00 "	48	46	46	46	46	46	48	48	48	48	46	50
11.00 "	48	46	46	46	46	46	48	48	48	48	48	48
12.00 m	48	46	46	48	48	46	48	48	48	48	46	48
1.00 p. m	50	48	48	48	48	48	48	48	48	48	48	48
2.00 "	40	44	44	46	44	44	46	46	46	46	46	46
3.00 "	38	42	42	42	42	40	42	42	42	42	42	42
4.00 "	38	38	40	40	40	38	40	40	40	40	40	40

TEST No. 77.

Hour.	Outside Temperature.	Temperature of Water in Canteens. All covers wet.										
		A	A A	B	C C	E	L	Q	R	S	T	U
7.40 a. m	+32	44	44	44	44	44	44	44	44	44	44	44
8.40 "	32	34	34	36	36	36	36	38	36	38	36	38
9.40 "	32	32	32	32	32	34	32	34	34	32	32	34
10.40 "	36	32	32	32	32	36	32	32	32	32	32	32
11.40 "	38	32	32	34	36	38	34	32	32	32	34	34
12.40 p. m	36	32	32	32	32	38	34	34	32	32	34	34
1.40 "	36	32	32	32	32	38	32	34	32	32	34	32
2.40 "	38	32	32	32	32	38	34	34	32	32	32	34
3.40 "	36	32	32	32	32	38	32	32	32	32	32	32

The following data and specifications regarding Canteens "AA," "BB," "CC," and the Lanz Canteens "Q" and "U" are given.

	"AA." ozs.	"BB." ozs.	"CC." ozs.	Lanz "Q." ozs.	Karlsruhe. Lanz "U." ozs.
Weight of the canteen, empty, covers on and dry	12¾		26	19	17
Weight of the canteen, filled, covers on and dry	58¼ av		64¾ av	67½ av	61 av
Weight of canteen, filled, covers on, after ten (10) minutes immersion	63½ av		74 av	77½ av	77½ av
Weight of the canteen flask, empty, no covers on	9½			11¾	9
Weight of water in canteen flask	45½ av 44 fd		44¾ av 43 fd	49 av 45½ fd	44 av 42¼ fd
Wt. of the duck, or canvas cover, dry	1¾	1¾	1¾	3½	3½
Wt. of the duck, or canvas cover, after ten (10) minutes immersion	3¼	3¼	2¾	5¼	5¼
Weight of the water absorbed by the canvas cover	1½	1½	1	2	2
Weight of the Petersham, felt, or inner cover, dry	1½	1½	2	3¾	3¾
Wt. of the Petersham, felt or inner cover, after ten(10)minutes Immersion	7½	7½	10½	15¼	15¼
Wt. of the water absorbed by the Petersham, felt, or inner cover	6	6	8½	11½	11½
Weight of the canteen, covers on and dry, filter in, empty		16			
Weight of the canteen, filled, covers on and dry, filter in		59 av			
Weight of the canteen, empty, filter out, covers on and dry		12¾			
Wt. of the canteen, filled, filter in, covers on, after ten (10) minutes immersion		64 av			
Wt. of water in canteen, filter in		42 av 40 fd			
Wt. of water in canteen, filter out		46 av 45 fd			
Weight of the tin flask, empty, no cover, filter out		9¾			
Wt. of filter, including soft rubber top		3¼			
Wt. of the enameled flask, empty, no covers on			16¼		
Wt. of duck, or canvas cover, and felt combined, dry				7¼	4½
Wt. of duck, or canvas cover, and felt combined, after ten (10) minutes immersion				19	17
Wt. of water absorbed by felt and canvas cover combined				11¼	12½

A discrepancy exists in comparing the gross weight of a canteen, covers on, after immersion, as a whole, in water for ten (10) minutes, as opposed to the result obtained by separately immersing and then weighing separately, the components of the canteen. This difference is due to the fact that the felt and canvas covers take up more water when off the flask of the canteen than they do when on the flask.

Illustration.—The gross weight of Canteen "AA," covers on, after ten (10) minutes immersion, canteen filled, was 63½ ounces, while the aggregate weight of same, separately weighed, after saturation of the covers, was 65¾ ounces, avoirdupois.

RECOMMENDATIONS, ETC.

It is recommended that the further manufacture, purchase, or issue, of the present service canteen cease, and that it be replaced by a canteen of different material, construction and shape.

That all canteens of the present regulation patterns, now in Arsenals or Depots of the U. S., be sold as unsuitable for the public service, after proper inspection and survey. This under the law of 23d March, 1825, upon which Section 1,241, Revised Statutes, is based.

That the Lanz method of covering be adopted for the tin canteen flasks now in process of fabrication at the Rock Island Arsenal. By the time that the 98,284 tin flasks now there have corroded,—a better material may be decided on. Aluminum is cheapening constantly. The regulation canteen is not durable. It is poor economy to continue it in service. The opinion and estimate of the man who carries and uses the canteen is preferable to the opinion or estimate of the man who made it. Fidelity to the welfare of the former, rather than the interests of the latter, prompts the recommendation. The *Bidon* of the French Army is said to have been determined by the men-in-ranks. Dr. Nicholas Senn, of 532 Dearborn Avenue, Chicago, Ill., is quoted as stating that the regulation canteen invites epidemics by sheltering the insidious disease germ. Further, that practical tests have demonstrated that there are other canteens having merits above that of the regulation canteen. Changing the material of the flask from sheet tin to enameled ware is the application of a false, even a dangerous, remedy. When a soldier raises a canteen to his mouth for the purpose of taking a drink, his lips embrace the rim of the neck of the flask so that the turned edges of the nozzle will come inside of his mouth. The lips of the drinker should not touch the fabric from which the cover of the canteen is made.

If the present pattern of canteen be retained, it is recommended that an openable outer cover of textile fabric be adopted instead of an outer cover fastened round the edges; further, that the inner cover now in use be replaced by a cover of all-wool felt of at least three times the weight, in ounces, of the present inner covering.

When an openable cover is laced up over the moistened felt, evaporation is retarded when the temperature of the atmosphere is considerably above temperate—and the fluid contents of the canteens thus kept at a palatable temperature for the soldier's use. The physical principle involved is manifest.

It is also evident that when the temperature of the atmosphere

is considerably below temperate, a canteen flask covered as recommended,—inner felt not being moistened,—will keep its contents at a palatable temperature for the soldier's use longer than if the present pattern and material of canteen coverings are retained in the service.

The modern canteen is not of circular, but of oval, gourd, oblong bottle, or flask, shape. It is recommended that one of these shapes be adopted for the U. S. Army conteen flask; also that the side of the flask that is next the body be flattened or slightly concaved, the other side being convex. I am of the opinion that the inner cover,—that is, the one superimposed upon the flask,—should be of absorbent material. Further, that the lacing method for the outer cover, extending partly around the edges of the flask, is durable as well as simple.

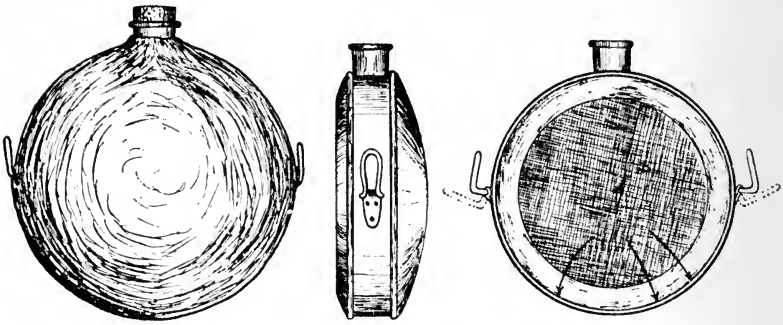
Destructive criticism is of no value in bringing about the solution of a problem. Certain existing facts in regard to the present service canteen have been stated. The settlement, remedy, and alternative, is commonplace and feasible. It consists in retiring the present regulation canteen issued to the Army, and adopting, in lieu, the Lanz Canteen.

Perhaps some one else will devise a better one; no one has, as yet, done so, or submitted a canteen which fulfills so many of the required qualifications of rational sense and principle desired in a canteen, as the Lanz Canteen Company, of Chicago, Ill. The U. S. Army should have the best that is offered. The Department having in charge the selection and issue of canteens should be in sympathetic touch with outside developments.

An objection advanced against the use of the Lanz Canteen is that the inner cover of all-wool felt will attract moths, and Government property thus be eaten up. Equally purile is the objection that as the inner cover of the Lanz Canteen is thicker in substance than the present regulation inner covers, it will soak up more water and thus increase the weight that the soldier has to carry;—of course, it will. The inner cover has functions; one function is to absorb several ounces of water in warm weather, when immersed. Unused idle canteen jackets of wool-felt may be eaten by moths if not protected just as storekeepers protect furs and woolens. Omelets cannot be made unless eggs be broken. Practical soldiers in the field would not object to a few ounces increased weight caused by the absorbent capacity of the felt covering, in view of the gain in palatableness of the fluid within caused by the soaked cover and

F

Aluminum flask, circular, made in Newark, N.J., covered by the Lanz method, double cover, felt and canvas. Capacity. 44 oz.; weight. 16 oz.



Arrows show where leakage began

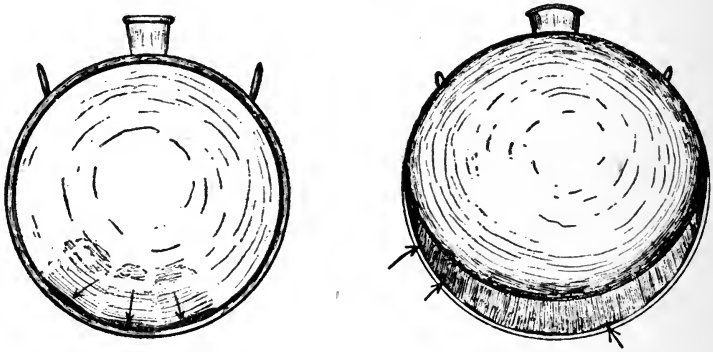
Scale: 1/3

O

Newark, N.J., Aluminum Canteen Flask, circular, no cover. No solder said to be used. Capacity, 16 oz., wt. 3¼ oz.

P

Raymond & Gottlob Aluminum Canteen. Single felt cover. Capacity, 29 oz. wt. 8 oz.



Scale: 1/2

Arrows show where leakage began

succeeding retarded evaporation secured by the outer canvas cover, in an arid region or on a sweltering day.

Believing that the canteen which most effectually performs its functions, viz.: to carry and preserve the temperature of the fluid it contains, either in hot or cold weather, to be the best for the military service, I recommend the Lanz Canteen as best fulfilling these requisites.

The new Lanz Canteen is of aluminum, one piece, oblong shape, one face concave, opposite side convex, covered with 4-8 inch all-wool felt; openable (3 piece) outer cover; has strap with rings in end to go round the flask and cover, through loops in latter.

The new Lanz Canteen is an ounce or so heavier, dry, and absorbs much more water than the government canteen. The removable canvas cover permits rapid saturation of the felt covering, when immersed, saturation being effected in a very few minutes. A Government canteen, which had been used, absorbed only one ounce of water in ten minutes, while the loose felt covering showed a capacity to absorb five ounces. Twelve hours' immersion of this canteen caused it to absorb only four ounces. The fixed canvas covering prevents access of water to the felt. The felt not being saturated loses its small amount of moisture comparatively soon and with the passing of evaporation the contents of the canteen soon become warm.

The Lanz Canteen absorbs its water quickly and its canvas cover placed dry over the wet felt retards evaporation and keeps the contents cool for a much longer period than the regulation canteen. Further, trials have proven that the Lanz Canteen will keep fluid at a palatable temperature in an Arctic region longer than the U. S. canteen will. The flask of the Lanz Canteen is lighter than the U. S. canteen and holds more water; further, the openable cover of the Lanz Canteen is as enduring as the U. S. cover, and possesses advantages that the U. S. cover does not possess.

The shape of the Lanz Canteen is considered an advantage by officers and men who have had field experience and who have tried it.

Attention is invited to drawings of six aluminum flasks, divested of their coverings, kept for sale by Mr. Lanz. Their capacities vary from 9-100 to 1.7 liter; none are circular in shape; all are oval; all are concave on one side, the opposite side being convex; some are dull finish—lusterless—some are polished; some have flat bottoms,—these last can stand up; some have drinking cups; some of the tops are screw tops.

My statements, opinions and recommendations regarding canteens have been based upon original test or examination, and not upon communicated information.

As regards the Lanz method of insulating canteens, my prepossessions were favorable, because the system seemed a common-sense one and the methods rational. Neither theory or bias, however, influenced my investigations nor my recommendations.

I did not accept the claims, tests, or results, or conclusions of any manufacturers of canteens, or material for canteens, or the components of canteens. I made my own tests.

The methods of tests and manner of making experiments are described on p. 77.

Fluid versus Avoirdupois, Measurement—It has been assumed throughout this monograph, that 455 and 7-10 grains constituted the fluid ounce, which is 18 and 2-10 in excess of an ounce avoirdupois. Manufacturers often state that the capacity of a flask is so-and-so many ounces, meaning ounces avoirdupois, not liquid measure.

Tinning and Retinning Sheet Steel Used in Making Canteen Flasks—Description of the Processes of Tinning and of Retinning Malleable Iron and Steel Plate.

The specifications for the regulation army canteen itemize that it shall be "made of XXXX tin, circular in shape, 7 and ¼ inches in diameter, sides oval and smooth, thickness through, three (3) inches", etc.

As the Ordnance Department has, for more than a generation, been making, or contracting for the making of canteen flasks "of XXXX tin", no treatise or monograph about military canteen is complete unaccompanied by a reference to sheet metal goods or articles of iron or steel coated with tin.

The coating of articles of iron and steel ware with zinc, or, as the process is generally known, "galvanizing" them, as a means of retarding oxidation and for other reasons, is an industry about which there is no mystery.

The tinning of malleable iron, or of steel, is an easy process to master. The price of the metal used to tin articles makes the cost of the material more than the labor cost.

The tinning of sheet steel, such as is used in making canteens and the retinning of tin ware, are special processes.

It is understood that the terms "X", or "XX", or "XXX", or

"XXXX" tin, as applied to sheet tin, refer to the thickness of the metal plus its tin coating.

Further, that four cross tin, or "XXXX" tin, is a sheet of tinned steel plate, thicker than three cross tin, "XXX" tin, that has been pickled, cleaned, immersed; first in a bath of molten tin; second, into a bath of hot tallow, or oil; third, passed, while the tin is still melted, through steel rollers running in the hot oil, that strip off all superfluous tin, leaving a thin, smooth, coating.

The tinplate used in making the regulation canteens that I have tested, has a coating of tin of about three (3) pounds to the box of 112 sheets of 14 x 20, or, say, .0138 pounds per square foot, two sides.

The best grade of tinplate made by the American Tinplate Company is known as "AAAA Charcoal", and has a coating of five (5) pounds to the box, or .023 pounds per square foot.

Either of these coatings is very light, and the action of the dies in drawing or stamping the canteen sides into shape injures the surface to some extent and has a tendency to make it porous, thus causing the steel plate to soon rust through the coating of tin.

The Lanz Manufacturing Co., of Chicago, claims that the proper way to make tin canteens is to retin them by the process employed on all fine stamped tinware; that is, to retin the sides of the canteen after they have been stamped into shape and before the sides have been soldered around the edges.

The process of retinning differs from the process of tinning the plate above outlined, and is as follows. No pickling is required.

In retinning the article is dipped by hand: first, into hot beef tallow or palm oil; second, into molten tin; third, it is drawn by hand through a pot of hot oil which gives a smooth, bright surface but does not remove the tin as do the rollers in making the plate. After the tin has "set," the article is hand rubbed in flour.

The coating left on the plate is equal to about 45 pounds to the 1,000 square feet, or .045 pounds per square foot, or nearly three times as much tin as is found on the surface of the average regulation canteen.

This retinning process, or Lanz method, of making canteens produces more durable ones, hence more desirable ones, than the tinning method. They should last three to four times as long as the regulation canteen now issued by the military establishment. They cost somewhat more, but are worth more.

The Lanz Manufacturing Co. also suggests, in addition to retinning the flask, that either a small piece of zinc be soldered to the

inside, or that the nozzle of the canteen be made of zinc,—as it is a well known fact that zinc and tin plate, soldered together, cause a slight galvanic action, which seems to prevent oxidation to some extent.

If any kind of tin canteen is retained in service, the advantages to be gained by the adoption by the U. S. of the Lanz method are unquestionable. Such is accordingly recommended, coupled with the further suggestion that this statement be referred to the Board of Ordnance, Fortification and Equipment, and also to the Chief of Ordnance, U. S. A.

I have inspected creamery, also cheese factory, appliances and dairy utensils at 316 Robert St., St. Paul, Minn., and elsewhere, made of XXXX Charcoal tin, retinned after they had been stamped into shape by the process observed by Mr. Lanz.

Some of these utensils, milk cans, separators, and other appliances had been in use for several years and subjected to very much the same kind of banging round that a soldier gives his canteen, but, in general, they showed only slight traces of rust, even in milk vats submerged in moving water.

The different processes of the coating of sheet metal goods and articles of iron and steel with zinc—"galvanizing"—them; also of tinning malleable iron, wrought iron, and steel; also of retinning the latter; in other words, the methods of coating with zinc and tin by immersion, are described and explained by W. T. Flanders, of Nashua, N. H., in a practical treatise, edition 1900, published by David Williams Co., 232-8 William St., N. Y. No description is known to me of processes of covering thin plates with aluminum of tin. The difficulties of a reliable solder would not appear to apply to such. If a tenacious coat of tin could be applied to a thin sheet of aluminum of requisite strength, durability, etc., the sheets of the latter so coated can be joined as securely as in the present regulation tin canteen,—it might be an improvment upon the present service canteen.

In a recent communication received from the New Jersey Aluminum Company, of Newark, N. J., the firm states: "We are forwarding you today by express two canteens made of aluminum, and all one piece, there being no seam or solder used. You will also observe that we have covered these in a crude way with felt, since you advocate not sending them naked. Our principal object now is to find out whether we have made a canteen that will stand the test such as you are liable to give it and as to whether we have caught your idea as to shape. These which we sent you would be the most

convenient to make. What we are after principally now is to find out whether we have made a canteen that will stand the test. We can readily make improvements as to covering and stoppers later on. We have spent some little money to produce these two samples and we sincerely hope that they will meet all requirements. We would thank you to acknowledge receipt and inform us later what the results are."

The Indian Aluminum Company, Limited, Manufacturers and Importers of Aluminum Ware, Mount Road, Madras, British India, write as follows:

"We have read your letter in the Aluminum World of February, 1901, and as there appears to be a reluctancy in coming forward on the part of some of the American manufacturers, we beg to forward you a sample of our 2-pint aluminum water bottle. We manufacture many patterns of different sizes, but this is a pattern which we have supplied many regiments in India. It is made out of one single piece of aluminum, without seams of any kind whatsoever, nor is it spun or pressed as in the case of the water bottle of German manufacture. We have entirely superseded the German manufacture of water bottles in India, and many officers have reported most favorably on the water bottles that we have supplied their regiments with.

"We regret to state that we do not quite understand your method of testing, but if you will be good enough to point out any flaws in the sample sent you, we would esteem it a favor and be quite prepared to remedy the defect in our future supply.

"We have made these bottles on one or two occasions of a size large enough to contain a gallon.

The Indian water bottle appears to be shaped like one of the cork sections of a life preserver belt. One face is concave, so as to fit close to the body. The outer face is convex. Ends are rounded. Top has four ventilating eyelets. The whole is covered with felt, or felted cloth, the thickness and weight of which are not described. It is not stated whether or not there is an inner cover or any substance between the felted cloth and the flask. It is provided with a carbine hook. See cuts No. 101-b, 102-c. It would be improved by the addition of an openable canvas cover over the felt to retard evaporation in hot weather. One pattern has a carry strap about its middle, buttoned by overlapping on the outside. Another pattern has a leather carry strap extending over its edges, also under the bottom. The strap is held in place by four leather loops, the latter being stitched to the felted cloth cover.

The New Jersey Aluminum Co., Newark, N. J., manifests activity and submits two oblong-shaped aluminum canteens, differing only in capacity, of its most recent manufacture. No seams or solder said to be used. Method of construction is not explained. In this report they are designated "MM" and "NN" respectively.

Canteen "MM"—Weight of naked flask, 9 and ¼ ounces; capacity 42 fluid ounces. Weight, filled, cover on and dry, 56 ounces, avoirdupois.

Canteen "NN"—Weight of naked flask, 7 and ¼ ounces; capacity, 38 and ½ fluid ounces. Weight, empty, dry cover on, cork in, 8 and ¼ ounces, avoirdupois. Weight, filled, cover dry, 49 ounces, avoirdupois.

Both have removable single felt covers, laced up on one side only, Lanz method; high collar.

BOARD OF ORDNANCE, FORTIFICATION AND EQUIPMENT.

It is submitted that the reports regarding canteens and the tests made thereof by me have shown: 1st. The advantages and disadvantages of the Lanz Canteen and cover system as compared with the Regulation Canteen. 2d. The advantages and disadvantages of the Lanz Canteen system as compared with other canteens differing from it in material, construction, or shape. 3d. The suitability of the Lanz Canteen for the use of troops in campaign, in the field, or on the march.

If the selection of a canteen rested with troops inured to tropical service, it is believed that they would choose the Lanz in preference to the Regulation Canteen or to any experimental canteen now under consideration.

There are certain obstinate facts hard to ignore. One is expressed tersely and comprehensively by Captain Alfred E. Bradley, Asst. Surgeon, Medical Dept., U. S. A., after a series of tests made at Fort Snelling, Minn., of the Regulation Canteen *versus* the Lanz Canteen. He writes: "The outer cover of the Regulation Canteen prevents the access of water to the felt. The felt, not being saturated, loses its small amount of water comparatively soon, and, with the passing of evaporation, the contents of the canteen soon become warm. The Lanz Canteen absorbs its water quickly, and its canvas cover, placed dry over the wet felt, retards evaporation and keeps the contents cool for a much longer period."

This statement of fact is, in a nutshell, a substantiation of the majority of the claims of the Lanz Canteen.

Success means the displacement of somebody, or something, or the survival of the strongest. Naturally, the Department charged with the manufacture and issue of canteens wants to continue to make the same. It follows that tests and experiments with a device originating with any inventor should be conducted along lines of the Department rather than those formulated by the inventor as essential in order to demonstrate the superiority of his device.

The Board of Ordnance, Fortification and Equipment is not circumstanced to conduct canteen tests in anything like the manner in which they would be tested by a soldier in the ranks in campaign time, in any climate, hot or cold.

The Board measurably relies upon tests, experiments, etc., made by those whose facilities, environments and opportunities enable them to do detail work.

It is recommended that the tests, experiments and recommendations regarding the Regulation Canteen *versus* the Lanz Canteen, and other canteens presented for use in the military service, or reported by the Inspector General, Dept. of Dakota, on dates in September, October and November, 1900, and transmitted to the Inspector General of the Army, through official channels, be referred for the consideration of the Board of Ordnance, Fortification and Equipment.

TEST No. 78.

Hour.	Outside Temperature.	Temperature of Water in Canteens. Each canteen was full. All covers were dry. All of the canteens were suspended from a trestle so that free circulation prevailed.											
		A	A A	B	C C	E	H	L	Q	R	S	T	U
7.35 a. m	†52	94	94	94	94	94	94	94	94	94	94	94	94
8.35 "	56	82	82	86	84	76	90	84	92	90	92	86	86
9.35 "	62	76	76	80	78	70	86	78	88	84	86	80	80
10.35 "	66	72	72	78	76	68	84	76	86	82	82	76	78
11.35 "	66	72	70	76	74	68	82	74	84	78	80	76	76
12.35 p. m	72	72	70	74	74	68	82	74	82	78	80	74	74
1.35 "	72	70	74	74	70	82	76	80	78	78	74	74	74
2.35 "	66	72	70	72	74	68	80	74	78	74	76	72	74
3.35 "	66	70	68	70	70	66	78	70	74	72	72	72	70
4.35 "	64	68	66	68	68	64	76	68	72	70	70	68	70

TEST No. 79.

Hour.	Outside Temperature.	Temperature of Water in Canteens. Each canteen was full. All covers were dry. All of the canteens were laid on a stone (granite) window sill, in the sun, and remained so exposed for nine (9) hours.											
		A	A A	B	C C	E	H	L	Q	R	S	T	U
7.40 a. m.....	+64	60	60	60	60	60	60	60	60	60	60	60	60
8.40 "	66	64	64	62	62	66	62	64	62	62	64	62	62
9.40 "	68	64	64	64	62	66	62	66	64	64	64	64	64
10.40 "	72	68	68	66	64	70	64	68	66	66	66	66	66
11.40 "	74	72	72	70	68	74	66	72	68	70	68	68	68
12.40 p. m.....	78	74	74	72	70	76	68	76	72	72	72	72	72
1.40 "	78	76	76	76	74	80	70	78	74	74	74	74	76
2.40 "	86	78	78	78	76	82	72	80	76	76	76	76	78
3.40 "	82	80	80	80	78	80	72	82	76	78	78	78	78
4.40 "	74	80	80	80	78	78	72	80	76	78	78	80	78

TEST No. 80.

Hour.	Outside Temperature.	Temperature of Water in Canteens. Each canteen was full. All felt covers were wet. Canvas covers were not immersed.											
		A	A A	B	C C	E	H	L	Q	R	S	T	U
7.35 a. m.....	+66	50	50	50	50	50	50	50	50	50	50	50	50
8.35 "	68	60	58	58	58	60	54	58	56	54	54	56	58
9.35 "	76	60	60	62	58	72	56	62	58	58	58	60	62
10.35 "	78	62	60	62	60	76	58	64	60	60	60	60	62
11.35 "	78	62	62	62	60	76	60	64	62	62	62	60	62
12.35 p, m.....	80	64	62	62	62	76	62	64	62	66	64	62	62
1.35 "	78	68	62	62	62	76	64	64	62	66	64	62	62
2.35 "	72	72	62	62	60	76	64	64	62	62	64	62	62
3.35 "	72	72	60	60	58	74	64	64	60	62	64	60	60
4.35 "	72	72	60	58	58	72	64	64	58	62	64	60	60

TEST No. 81.

Honr.	Outside Temperature.	Temperature of Water in Canteens. Each canteen was filled. All felt, or other covers were wet. The canteens were suspended from a trestle placed on the L of the Army Building, St. Paul, Minn. Not in contact. Free circulation of air prevailed.												
		A	A A	B	C C	E	H	L	M M	Q	R	S	T	U
7.40 a.m.....	+72	46	46	46	46	46	46	46	46	46	46	46	46	46
8.40 "	82	64	60	58	60	64	54	60	64	58	58	60	60	60
9.40 "	84	66	64	64	66	74	58	64	66	62	62	64	62	64
10.40 "	84	64	64	64	66	78	60	64	66	64	64	62	62	64
11.40 "	80	62	62	62	62	76	62	62	64	60	62	60	62	62
12.40 p.m.....	84	68	60	60	62	78	64	62	64	62	62	60	60	62
1.40 "	84	72	62	62	60	82	64	64	66	60	62	60	60	62
2.40 "	74	78	64	62	60	78	64	64	66	60	60	60	60	60
3.40 "	74	76	62	60	60	74	64	64	68	58	60	60	60	60
4.40 "	74	74	58	58	63	74	62	68	68	58	60	60	58	60

TEST No. 82.

Hour.	Outside Temperature.	Temperature of Water in Canteens. Each canteen was filled. Canteens "A"—Regulation—and "Q," also "R" and "S"—Lanz—had dry covers. All other canteens were immersed for ten (10) minutes. Openable canvas covers were not immersed. All of the canteens were laid on a stone (granite) window sill in the sun and remained so exposed for nine (9) hours.												
		A	A A	B	C C	E	H	L	MM	Q	R	S	T	U
7.45 a.m.....	+68	48	48	48	48	48	48	48	48	48	48	48	48	48
8.45 "	72	58	58	56	58	64	56	56	58	52	54	54	56	56
9.45 "	76	64	60	60	60	72	58	60	62	56	58	56	60	58
10.45 "	78	72	64	62	62	78	58	62	64	60	62	62	62	62
11.45 "	80	78	66	66	64	80	60	66	68	64	66	66	66	64
12.45 p.m.....	82	82	70	68	66	84	64	70	72	68	70	70	68	68
1.45 "	84	84	74	68	68	86	64	76	78	72	74	72	70	70
2.45 "	84	86	78	72	72	86	66	80	82	76	76	74	72	70
3.45 "	82	86	82	72	76	86	68	82	86	78	76	76	72	70
4.45 "	80	86	84	74	76	84	68	82	84	80	76	76	70	70

TEST No. 83.

Hour.	Outside Temperature.	Temperature of Water in Canteens. Each canteen was filled. All canteens were immersed for ten (10) minutes. Removable canvas covers were not immersed. All of the canteens were suspended from a trestle placed in the sun on the roof of the Army Building, St. Paul, and remained so exposed for eight (8) hours.											
		A	A A	B	C C	E	L	MM	Q	R	S	T	U
7.45 a. m.....	+70	50	50	50	50	50	50	50	50	50	50	50	50
8.45 "	80	62	62	62	62	66	62	62	62	58	62	62	60
9.45 "	78	64	64	64	64	70	64	64	64	62	64	64	62
10.45 "	78	66	66	66	64	76	66	66	64	62	66	66	64
11-45 "	84	68	66	66	66	80	66	68	68	66	66	68	66
12.45 p. m.....	88	70	68	68	66	86	70	70	68	68	68	70	68
1.45 "	88	74	70	68	68	86	70	70	70	70	68	68	68
2.45 "	78	78	68	68	66	84	70	70	68	70	68	68	68
3.45 "	72	78	66	64	62	80	70	66	64	68	64	64	62

TEST No. 84.

Hour.	Outside Temperature.	Temperature of Water in Canteens. All of the canteens were filled. Each canteen was immersed for ten (10) minutes. Openable canvas covers were not immersed All of the canteens were then laid on a stone (granite) window sill in the sun, on the roof of the Army Building, St. Paul, Minn., and remained so exposed for nine (9) hours.											
		A	A A	B	C C	E	L	MM	Q	R	S	T	U
8.15 a. m.....	+70	50	50	50	50	50	50	50	50	50	50	50	50
9.15 "	72	62	60	60	60	64	60	62	58	58	56	58	58
10.15 "	82	68	66	64	64	72	64	66	62	62	62	64	62
11.15 "	88	72	70	70	68	82	68	72	66	66	66	68	66
12.15 p. m.....	84	72	70	70	70	88	70	74	68	70	68	70	68
1.15 "	84	76	72	72	70	92	74	76	72	74	72	72	70
2.15 "	80	80	72	70	70	86	76	76	72	74	72	70	70
3.15 "	84	82	74	72	72	86	78	78	72	74	72	72	72
4.15 "	84	84	76	72	72	86	80	80	74	76	74	72	72
5.15 "	80	84	78	72	72	84	80	82	74	76	74	72	72

TEST No. 85.

Hour.	Outside Temperature	Temperature of Water in Canteens. All of the canteens were filled. Each canteen was immersed for ten (10) minutes. Openable canvas covers were not immersed. All of the canteens were then suspended from a trestle in the sun, exposed on the roof of the L of Army Building, St. Paul, Minn.											
		A	A A	B	C C	E	L	MM	Q	R	S	T	U
7.45 a. m	+80	50	50	50	50	50	50	50	50	50	50	50	50
8.45 "	86	68	64	66	64	68	66	66	62	60	60	64	62
9.45 "	92	70	68	70	68	80	70	70	66	64	66	68	66
10.45 "	94	72	70	72	72	86	72	72	70	68	70	70	70
11.45 "	100	74	72	72	72	88	74	74	72	70	74	72	72
12.45 p. m	100	82	72	76	72	94	78	74	74	76	76	72	74
1.45 "	100	90	78	76	72	98	82	78	74	76	76	74	76
2.45 "	100	94	82	78	74	100	90	84	76	80	80	76	78
3.45 "	92	98	86	76	74	102	92	88	80	82	80	76	80
4.45 "	90	98	90	78	74	100	94	90	78	82	80	74	78

TEST No. 86.

Hour.	Outside Temperature.	Temperature of Water in Canteens. Conditions: Same as in preceding Test—No. 85.											
		A	A A	B	C C	E	L	MM	Q	R	S	T	U
7.45 a. m	+86	48	48	48	48	48	48	48	48	48	48	48	48
8.45 "	90	68	66	66	68	70	68	68	64	60	62	64	60
9.45 "	92	72	68	70	70	80	70	74	68	66	66	70	66
10.45 "	96	74	72	72	74	88	74	76	72	70	70	72	70
11.45 "	98	78	74	74	74	94	76	78	74	74	72	76	72
12.45 p. m	104	88	76	76	74	100	80	80	76	78	74	78	76
1.45 "	104	94	80	78	76	102	84	82	78	80	76	82	80
2.45 "	104	98	88	78	76	102	90	88	78	82	78	82	82
3.45 "	94	98	92	78	78	98	96	92	80	82	80	82	84
4.45 "	94	96	94	78	78	94	94	92	80	82	80	80	82

TEST No. 87.

Hour.	Outside Temperature.	Temperature of Water in Canteens. All of the canteens were filled. All of the canteens were immersed, both covers on, for ten (10) minutes before being exposed to the sun, suspended from a trestle placed on the roof of the L of the Army Building, St. Paul, Minn.											
		A	A A	B	C C	E	L	MM	Q	R	S	T	U
7.45 a. m	+78	50	50	50	50	50	50	50	50	50	50	50	50
8.45 "	80	66	64	62	64	74	66	64	60	60	58	62	62
9.45 "	84	70	68	68	66	82	70	70	64	64	64	68	64
10.45 "	88	70	68	70	68	88	70	70	66	66	66	68	66
11.45 "	88	76	68	70	68	88	72	70	68	68	70	70	68
12.45 p. m	90	80	68	70	68	92	72	72	68	72	70	70	70
1.45 "	90	86	72	70	68	92	78	80	68	74	70	70	70
2.45 "	88	88	76	70	68	90	84	86	70	74	72	72	72
3.45 "	80	86	78	70	72	86	82	86	72	76	72	70	74
4.45 "	80	84	78	70	72	84	82	84	72	76	72	68	74

TEST No. 88.

Hour.	Outside Temperature.	Temperature of Water in Canteens. Conditions same as in Test No. 87.											
		A	A A	B	C C	E	L	M M	Q	R	S	T	U
7.45 a. m.	+58	50	50	50	50	50	50	50	50	50	50	50	50
8.45 "	66	54	52	52	52	64	54	54	54	54	54	54	54
9.45 "	70	58	56	56	56	70	56	56	54	54	54	54	56
10.45 "	72	58	56	56	56	72	58	60	56	56	56	56	56
11.45 "	78	62	58	58	58	78	60	60	58	58	58	58	58
12.45 p. m.	80	68	60	60	58	80	62	62	58	60	60	58	60
1.45 "	80	76	64	62	60	82	68	66	60	62	62	62	60
2.45 "	78	80	68	62	64	82	74	72	62	64	66	62	62
3.45 "	76	82	72	64	66	82	76	76	64	66	66	62	64
4.45 "	76	82	72	64	68	80	76	76	64	66	66	62	64

TEST No. 89.

Hour.	Outside Temperature.	Temperature of Water in Canteens. All openable canvas covers were removed before immersing the felt covered canteens for ten (10) minutes. The dry canvas covers were then replaced over the wet felt and canteens exposed same as in Test No. 88.											
		A	A A	B	C C	E	L	M M	Q	R	S	T	U
7.40 a. m.	+64	50	50	50	50	50	50	50	50	50	50	50	50
8.40 "	66	58	56	56	58	66	58	58	54	62	54	58	56
9.40 "	72	60	60	58	58	70	60	60	56	62	58	60	58
10.40 "	72	62	62	60	60	72	62	62	58	62	58	62	58
11.40 "	82	64	62	62	62	76	64	64	60	64	60	64	60
12.40 p. m.	82	68	64	64	66	82	66	66	66	66	66	66	66
1.40 "	88	74	66	66	66	86	70	68	68	68	68	68	68
2.40 "	82	78	68	66	66	86	70	70	70	70	70	68	68
3.40 "	82	82	70	68	66	88	76	76	72	72	70	70	68
4.40 "	80	82	70	68	66	86	78	78	74	72	72	70	68

TEST No. 90.

Hour.	Outside Temperature.	Temperature of Water in Canteens. Canvas and felt covers immersed for ten (10) minutes before commencing test.											
		A	A A	B	C C	E	L	M M	Q	R	S	T	U
7.45 a. m.	+62	52	52	52	52	52	52	52	52	52	52	52	52
8.45 "	62	56	54	54	54	58	54	56	52	54	52	54	54
9.45 "	64	56	56	56	56	62	56	56	54	56	56	56	54
10.45 "	60	58	58	56	56	58	58	56	56	56	56	56	56
11.45 "	62	58	58	56	56	62	58	58	56	56	56	56	56
12.45 p. m.	60	58	58	56	56	62	58	58	56	56	56	56	56
1.45 "	62	58	58	58	58	62	58	58	58	56	58	58	58
2.45 "	64	58	58	58	58	60	60	60	58	58	58	58	58
3.45 "	66	60	60	60	58	62	60	60	58	58	60	60	58
4.45 "	64	60	60	58	60	64	60	58	60	60	60	58	58

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TEST No. 91.

Hour.	Outside Temperatvre.	Temperature of Water in Canteens. All canvas covers removed before immersing canteens for ten (10) minutes. Canvas covers then replaced over wet felt, before commencement of test.											
		A	A A	B	C C	E	L	MM	Q	R	S	T	U
8.00 a. m.	†72	52	52	52	52	52	52	52	52	52	52	52	52
9.00 "	76	60	58	58	56	62	58	58	56	58	56	58	56
10.00 "	80	64	60	62	60	70	62	64	60	60	58	60	58
11.00 "	84	64	64	64	62	74	64	66	62	62	62	64	62
12.00 m.	84	66	66	66	64	78	68	68	64	64	64	66	64
1.00 p. m	86	66	66	68	66	80	68	68	66	68	66	66	66
2.00 "	84	66	66	66	66	82	68	68	66	68	66	66	68
3.00 "	84	72	66	66	66	84	70	68	68	70	68	68	70
4.00 "	86	76	66	68	66	86	70	70	68	72	68	70	70
5.00 "	88	78	66	68	66	86	72	70	68	72	68	70	72

TEST No. 92.

Hour.	Outside Temperature.	Temperature of Water in Canteens. Both canvas outer, and felt **inner** covers immersed for ten (10) minutes before commencement of test.											
		A	A A	B	C C	E	L	MM	Q	R	S	T	U
8.00 a. m	68	50	50	50	50	50	50	50	50	50	50	50	50
9.00 "	70	60	60	60	60	64	60	62	58	56	58	60	58
10.00 "	70	62	62	62	68	62	64	62	60	60	62	62	62
11.00 "	62	60	60	60	60	64	62	60	60	60	60	60	62
12.00 m-	58	56	56	56	56	62	58	56	56	58	58	58	58
1.00 p. m	60	54	54	54	52	60	56	54	54	56	56	54	56
2.00 "	60	52	52	52	52	60	52	54	54	56	56	52	54
3.00 "	58	50	50	50	50	60	50	52	50	54	52	52	52
4.00 "	58	50	48	50	48	60	50	50	50	54	50	50	52
5.00 "	62	52	50	50	50	62	52	50	50	54	50	50	52

TEST No. 93.

Hour.	Out-side Temp.	Temperature of Water in Canteens. All canteens filled and covers dry.													
		A	A A	B	C C	E	L	MM	Q	R	S	T	U	Y*	Z†
9.00 a.m	†82	52	52	52	52	52	52	52	52	52	52	52	52	52	52
10.00 "	84	60	62	60	58	64	62	62	58	58	58	58	58	64	64
11.00 "	90	72	70	68	68	80	70	72	64	66	66	66	66	74	72
12.00 m.	92	82	78	74	76	88	78	78	70	72	70	70	70	80	78
1.00 p.m	100	86	86	82	82	92	86	86	74	76	76	76	76	84	84
2.00 "	98	90	90	86	88	96	90	90	80	80	80	80	80	88	86
3.00 "	92	92	90	90	90	94	90	92	82	82	82	84	84	86	84
4.00 "	90	90	90	90	90	90	90	90	84	84	84	84	84	86	86
5.00 "	90	88	90	90	88	90	90	90	84	84	84	86	86	86	86

TEST No. 94.

Hour.	Out-side Temp.	Temperature of Water in Canteens. All canteens filled and covers dry except Canteen "T," the covers of which were wet.														
		A	A A	B	C C	E	L	MM	Q	R	S	T	U	Y*	Z†
7.40 a. m.	+82	54	54	54	54	54	54	54	54	54	54	54	54	54	54
8.40 "	86	64	62	62	62	68	64	66	62	60	60	62	62	64	64
9.40 "	100	70	68	70	68	78	70	72	68	64	68	68	66	72	72
10.40 "	100	72	72	72	72	88	74	74	72	68	70	70	72	80	78
11.40 "	100	72	72	74	74	90	76	76	74	70	72	72	72	82	82
12.40 p. m.	96	76	74	74	74	94	76	76	76	76	74	74	74	86	86
1.40 "	98	78	74	74	74	94	76	76	76	76	74	74	74	88	86
2.40 "	100	86	78	74	74	96	82	80	76	78	76	74	74	90	90
3.40 "	98	92	82	76	74	96	88	88	78	80	78	76	76	90	90
4.40 "	92	96	86	76	76	96	92	92	78	82	78	74	78	92	90

TEST No. 95.

Hour.	Out-side Temp.	Temperature of Water in Canteens. Conditions: Same as in Test No. 94.														
		A	A A	B	C C	E	L	MM	Q	R	S	T	U	Y*	Z†
7.30 a. m.	+86	54	54	54	54	54	54	54	54	54	54	54	54	54	54
8.30 "	92	70	72	68	68	72	72	72	70	66	64	68	68	68	66
9.30 "	100	74	76	72	72	78	74	74	74	70	68	72	72	72	72
10.30 "	100	78	78	78	76	84	78	78	76	72	72	76	76	80	78
11.30 "	104	78	78	78	76	96	80	80	76	78	76	78	76	86	84
12.30 p. m.	104	82	78	78	76	98	80	80	76	80	78	78	76	90	88
1.30 "	104	88	78	78	78	100	82	80	78	80	78	78	78	92	90
2.30 "	100	94	82	78	78	100	84	84	78	82	78	78	80	92	90
3.30 "	96	96	84	76	74	98	90	90	76	82	80	76	76	92	92
4.30 "	92	96	86	76	76	96	90	92	76	84	78	76	78	92	90

*DESCRIPTION OF CANTEEN "Y."—From Messrs. Hormann, Schutte & Co., Cannstatt a Necker, Germany. Aluminum, 99% pure, drawn and pressed out of one solid piece. Mouthpiece, two pressed parts. No cover. Weight of flask, 8¼ ozs. Capacity, 46 fluid ounces. Weight, filled, 57½ ounces, avoirdupois.

†DESCRIPTION OF CANTEEN "Z."—Circular Aluminum flask, made by the Griswold Manufacturing Co., Erie, Pa. Cast, including lug, from a wood pattern and wood core box. No cover. Weight of flask, 17¾ ounces. Capacity, 52 fluid ounces. Weight, filled, 72 ounces.

RECORD OF CANTEEN "F."

Synopsis of tests, open-air, made at Headquarters, Department of Dakota, St. Paul, Minn., of the Newark, N. J. Aluminum Flask—Circular Canteen; no solder said to be used: Covered by the Lanz method with ⅜-inch felt; openable canvas cover. Capacity, 44 ounces. Weight 16 ounces. Termed in this monograph, Canteen "F."

No. of Tests.....33. Frozen in Test No. 30; also in No. 38.
Test No. 33,.....leakage first noticed. Test No. 38.....leakage established.

No. of Test.	Outside Temperature.		Temperature of Water in Canteen.		
	Maximum.	Minimum.	Maximum.	Minimum.	
30	+ 8	+ 7	+ 54	+32	Frozen withdrawn.
31	12	10	52	32	
32	14	14	56	32	
33	23	20	112	32	Leaked after first hour.
34	34	32	110	44	" " " "
35	41	32	116	48	
36	32	25	116	42	
37	40	22	116	52	
38	36	32	100	48	Leaked.
39	42	38	94	52	"
40	14	12	96	32	"
41	28	10	98	36	"
42	26	22	94	32	"
43	12	4	94	32	"
44	34	14	106	38	"
45	− 2	−10	74	32	
46	Zero.	10	102	32	
47	+28	+14	90	34	
48	18	14	80	32	Frozen.
49	18	8	130	34	Leaky.
50	24	4	50	32	"
51	16	8	56	32	"
52	14	2	178	32	"
53	28	18	168	38	"
54	30	22	170	44	"
55	22	8	52	32	"
56	38	24	50	38	"
57	42	32	52	42	"
58	18	12	54	32	"
59	2	− 4	52	32	"
60	20	+ 2	170	38	"
61	20	Zero.	172	32	"
62	22	20	168	32	"
Highest...	+42	−10	+178	+32	

The record of Canteen "F," covering a period of thirty-four (34) days, is given in extenso in order to illustrate, practically, the thoroughness with which all tests were conducted. My tests were not based on any theory. My recommendations have been based upon the results of numerous tests under varying conditions.

Aluminum and its alloys is such a satisfactory metal to make canteen flasks of—if the metal could be satisfactorily soldered—that I part with it with reluctance. The aluminum manufacturers have not yet, to my knowledge, succeeded in making a canteen flask that will meet the requirements of the military service.

A COMPARISON.

The Regulation Versus the Lanz Canteen.

Thought was applied and experiments conducted in the U. S. Army more than a quarter of a century ago to the solution of the question of how to keep water in a tin canteen palatable in a hot region. It resolved itself into the adoption of the present Regulation Canteen. The formation of judgment regarding a canteen suitable for military use is slow work. It is easy to arrive at a conclusion regarding a device that is merely a receptacle to hold liquids in for the consumption of tourists, sportsmen, and bicyclists, on a summer outing. My conclusions are that the Regulation Canteen fails to secure the benefits of a prolonged evaporative action for as long a time as the Lanz Canteen does. The Lanz Canteen prevents rapid changes of temperature of its contents. Its shape and method of construction,—both as regards the metallic flask and its components, the covers,—differ from other canteens. The means, methods and principles involved, physical, mechanical and rational, are elsewhere described in this monograph. In cold weather, the dry felt is an effective non-conductor of heat. In hot weather the saturated—canvas encased—cover of all-wool felt applied to the filled metallic flask continues moist for a number of hours longer than any other canteen, hence possesses the merit of keeping the fluid contents cool and relishable for a maximum period.

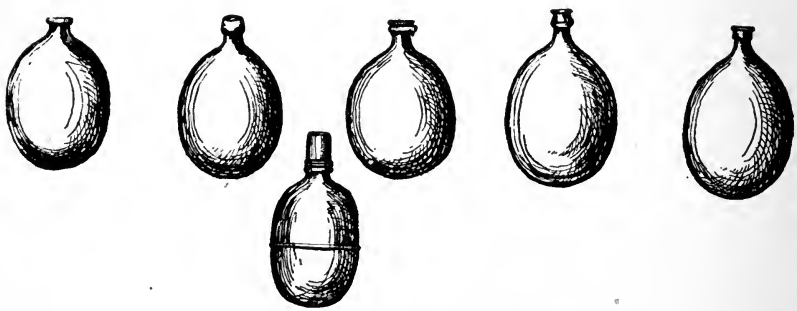
A defect of the Regulation Canteen is that it is impracticable to easily thoroughly saturate the inner felt, or Petersham, cover. After a little field service, the outer canvas cover accumulates grease, dirt, etc., to such an extent as to become nearly water-proof, despite immersion; hence there is little cooling action by evaporation. Herein one of the advantages of the Lanz Canteen applies, because it has an openable cover, whereas the Regulation cover is permanently attached, unless the stitches are cut.

The musket carried by our army during the civil war period, 1861-5, could put an enemy out of action at a range of 600 yards, but the effective range of the Springfield muzzle-loader was limited as compared with the Cal. 30 U. S. Magazine Rifle, sheathed projectile, with which our troops are now armed. The energy and penetration of the latter at a range in excess of two miles is known. The determination of the relative merits of the old caliber .45 small firearm of projection, as compared with the rifle at present in the hands of our soldiers, should not rest upon the limitations of the Springfield, but upon the far-reaching powers of the Krag-Jorgenson.

As it is with firearms, so it is with canteens.

For a number of hours, say, six, the Regulation Canteen will, under ordinary circumstances and moderately uniform temperature, keep water as cool as the Lanz; but, after the water absorbed by the covers of the Regulation Canteen has evaporated and the contents thus begun to rise in temperature, the Lanz Canteen will continue to keep its contents at a lower, therefore more relishable, temperature than the Regulation Canteen.

Aluminum Flask for Canteens, Single piece, made in Karlsruhe, Baden, Germany, furnished for test by the Lanz Canteen Co., Chicago, Ill.



A full and impartial consideration of the merits of a canteen intended for use in the field, during a campaign, or on the march, cannot be said to have been effected until the canteen has been given exhaustive tests assimilating to such practical tests as would be given it by soldiers in any climate, hot or cold.

My official reports show that I have given numerous canteens these tests in environments of outside temperature varying from minus ten (10) degrees F. to plus one hundred and twenty-five (125) degrees F.

My conclusion and recommendation is that the Lanz Canteen warrants a trial with a view to its adoption in the U. S. Army.

Factors to be taken into consideration in the selection of a Canteen intended for use in the Military Service.

- MATERIAL
  - Aluminum
    - Spun.
    - Cast.
    - Pressed.
    - Stamped.
    - Welded.
    - Rolled, or Sheet, Metal.
  - Tin.
  - Ebonite.
  - Wood.
  - Enameled Metal.
  - Tinned "
  - Galvanized "
  - Other Metals.
- CANTEEN
  - Construction
    - Single Piece
      - Side Pieces, Ears or Loops, attached to flask.
    - Joined Pieces
      - Loops attached to Cover.
  - Shape
    - Oval
      - Concave-convex faces.
    - Oblong
      - Covex faces.
    - Gourd
      - Cylindrical.
    - Bottle shaped
      - Flat.
    - Circular
      - One face flat, opposite face curved.
  - Components
    - Flask
      - Durability.
      - Weight.
      - Capacity.
    - Inside Cover
      - All-wool Felt.
      - Felted Cloth.
      - Sponge Cloth.
    - Outside Cover
      - Duck, or Canvas.
      - Any textile fabric.
      - Leather.
    - Mouth Piece.
    - Stopper.
    - Chain.
    - Triangles, or Side Pieces.

Queries.

Can air-pressure be utilized in lieu of the inside water-pressure used, as stated by the Pittsburgh Reduction Co., in shaping spun aluminum canteen flasks?

Will a cast aluminum flask prove as durable as a flask of spun aluminum?

How can triangles, ears, lugs, or rings be substantially fastened at the sides of an aluminum flask, and thus do away with a strap around the cover?

By what method is the Canteen Flask made?

"Uber Feldflaschen und Kochgeschirre aus Aluminum. Im Augtrage des k. Kriegsministeriums bearbeitet von Dr. Plagge, Stabsarzt, und Georg Lebbin, Chemiker. (Canteen and cooking utensils of aluminum. Prepared by direction of the war ministry by Dr. Plagge, staff surgeon, and George Lebbin, chemist.) 100 pp. Berlin, 1893":—

EXTRACT.

"Three kinds of tests:

(1) Rough, practical usefulness.

(2) Durability, wearing qualities and cost from an economical point of view.

(3) Question of hygiene and harmfulness or harmlessness of aluminum vessels.

The final result of these tests and trials amount to this: That neither from a practical nor from an economical point of view essential arguments against the feasibility of using aluminum field flasks exist, and that from a sanitary standpoint such flasks can be utilized without the least hesitation.

* * * * * * * * *

Regarding the rough practical usefulness, the question arises whether or not the taste of the fluid contained in the aluminum flask is in any way changed. This is not the case. Neither water, nor coffee, nor water mixed with vinegar; beer, wine, brandy (cognac) and other spirituous liquors, lemonade, etc., show a change in taste, particularly no after-taste of aluminum, even after the contents had remained in the flask for a week.

Although a change in the taste of the contents of a properly cleaned aluminum flask does not occur, there are some liquids which appear to be unsuited to be kept for any length of time in such flasks. They become cloudy or muddy and cause the formation of spots or stains. Among them are, as practical tests in the army have demonstrated, brandy (cognac) which, after only twenty-four hours' preservation in the flask, particularly in a warm temperature, caused the formation of peculiar dark brown spots or stains on the inside of the flask.

In order to determine the nature of the spots, tests were made with various liquors, i. e., three kinds of cognac, two kinds of Nordhauser (corn whisky), herb liquor, Dantzig Goldwater and Kuemmel.

* * * * * * * * *

These experiments proved that aluminum flasks are not adapted for a lengthy preservation of such liquids as cognac, etc., which,

although not losing particularly in taste, lose their appetizing qualities by becoming clouded, the discoloration being caused by loosening of the stains from the flask and mixing with the liquor.

This, however, hardly impairs the practical usefulness of the aluminum flask for the army. A soldier generally carries coffee or water in his flask, not liquor, the latter being, particularly on marches, at least in the infantry, expressly prohibited.

Of other liquids carried in the flask, coffee, the standard drink of the marching soldier, should be considered; but the stains created by it (amounting to the size of a pin head after 24 hours) are so inconsiderable that all practical objection will disappear when it is considered that the coffee, which in itself is not entirely clear, does not lose its taste and is generally kept in the flask for a much shorter period.

Another kind of stains of whitish color in aluminum field flasks must be considered. They are caused by leaving water standing quiet in an aluminum vessel for any length of time.

Although the resistance of the metal to the action of the water,—and especially of distilled water,—is undoubted, yet weak solutions of salt, which are contained in most of our drinking waters, bring about the above mentioned phenomenon, after the water has remained in the vessels for hours.

These stains resemble the brandy stains to a great extent, but are of a lighter color, being yellowish-white, and feel firm and sandy, while the cognac stains are of an even, loose or spongy nature.

Those whitish stains also appear much slower, generally not after several days.

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So far as the question of economy is concerned, it is to be emphasized that the aluminum field flasks during these many and varied tests and experiments, continued for months, including their being placed in incubators and shaking apparatus (the latter imitating the movement of a marching soldier), have shown themselves as very durable and strong, and that a leakage has never occurred. Whether, in this respect, they will satisfy the demands of field service, can only be demonstrated by practical carrying tests. As the softness of the metal facilitates a possibility of damage to the flask, it is a matter of importance that lately a number of sure methods of soldering aluminum have been found, which process, as is well known, was not quite successful at first."

The Patton Paint Company, Milwaukee, Wis., (see p. 104), writes: "We have come to a point now where we desire to get hold of the canteen itself made of wood and will ask you to inform us whether you know of such a canteen already made up. If not, we shall be obliged to have a few made by some wood working company, as we are now ready to give the paint a test on the canteen as it will be used in service."

The Griswold Manufacturing Company, Erie, Pa., (see pp. 48-9), writes as follows: "In reply to yours in regard to the canteen, would say, we had to make several changes in our pattern, which delayed us in getting out the sample. We have this all finished, so we will be able to make castings to-day or to-morrow, and expect to be able to send you sample for your test the very first of next week. We trust this will not be too late, and that you will hold your tests open so you can include our sample in the same. We know we can be successful in making a cast canteen all in one piece, which would certainly be much stronger than the sheet aluminum one, and there will be no rivets projecting through, which are weak points, as it soon corrodes around the rivets. We shall *cast a lug* on the outside on which to fasten the ring for the strap. Trusting you can, therefore, hold the tests open, and assuring you we will send sample in a very few days, we remain," etc.

Hormann, Schutte & Co., Importers and General Commission Merchants, 24 and 26 W. 4th St., New York, write as follows:

"One of our friends called our attention to your article in the *Aluminum World* of March, 1901. We understand from this that you take great interest in aluminum articles, especially canteens for the U. S. Army, and as we represent the largest manufacturer in the world who makes a specialty of aluminum canteens and cooking utensils for military purposes, having supplied all the European armies and still supplying them with all they need in this line, we are sure we could give you some valuable information and successfully compete with any manufacturer in this line of goods. We would be only too pleased to furnish you with samples which you might test and also with lowest quotations, if you will have the kindness to inform us what you may need to make your test, and also give you any other information which might possibly interest you and which we are in a position to furnish." * * *

The above mentioned firm—Messrs. Hormann, Schutte & Co.—again write:—"We confirm our previous letter and have taken the

liberty of sending you a sample of an aluminum canteen, which we just this moment received from our manufacturer.

"This canteen has been drawn and pressed out of one solid piece of pure aluminum plate, 99 per cent pure aluminum.

"The mouthpiece consists of two pressed parts to give strength to the neck.

"In case that this canteen should, in your opinion, not have resistance enough, it is easy for the manufacturer to make them out of a heavier plate with a thicker wall.

"The size, shape, etc., the manufacturer would be willing to make absolutely in accordance with your instructions.

"Kindly test this canteen thoroughly and see whether the same would come in every respect up to your expectation and answer your purpose thoroughly.

"We would be much obliged to hear from you."

Messrs. Herm. Weissenburger & Co., Cannstatt a. Necker write as follows:—"We thank you for your kind favor of 10th instant, but not seeing our way to compete successfully with the U. S. manufacturers on account of heavy duty, we have decided to keep back, although the order would suit us very well.

"We have invented a new helmet, a combination of Aluminum, leather and Pegamoid, light and rigid, perhaps with this article, which we can protect in the U. S., we shall have better luck. We shall send you a sample later."

The Griswold Manufacturing Company, Erie, Pa., (see also preceding pages 48-9 and 87), write again:—"We are shipping you by American Express today, prepaid, sample of cast Aluminum flask. We are sending you this flask without any cork, as we were in a great hurry to ship it to you. Did not have time to make the metal trimmings and chain that you would require on the cork. These small details we can easily fix any requirements you would want.

"This flask was tested with water pressure of 50 pounds to the square inch. It stood the test all right, except we bent out the flat side slightly. Would say, this flat side is a little thinner than the other.

"This flask was cast from just a wooden pattern and wood core box. It is difficult to hold the core exactly true. If we should make them we would use metal patterns and core boxes, and fit up so they would come exact even thickness, and we hope then to get them a trifle lighter.

"Of course, we understand the flasks would have to be furnished with felt or cloth covering, we presume also the chains and straps, but our idea in sending you this bare sample is to get your opinion whether a cast flask is practical, and if there would be any chance of it being adopted. If so, we stand ready to go ahead at once and get up a more perfect sample, equipped with all details, coverings, etc.

"This flask, of course, is heavier than one made of sheet aluminum, and we did not know but the weight would be against it. On the other hand, it is a good deal stronger, and there are no rivets through the same where the chains are fastened on, which is a very weak point on a sheet aluminum flask, as the water will immediately begin to corrode around the rivet heads.

"Also, there are no joints or soldered places in the flask. We trust this will reach you in time for you to include it in your report, and we await with interest your reply.

"We stand ready to make any changes, and to furnish you with completely fitted up sample, as you may request.

"We also believe this flask is a little larger than the regulation requirements."

The Indian Aluminum Company, Limited, Madras, British India, (see page 77), writes again as follows:—"Since the dispatch of our letter of the 21st ultimo, we have received the copy of the *Aluminum World* for March and have read with much interest your letter, wherein we note that the articles submitted to you for test are experimented with until they are practically destroyed. We cannot claim that our water bottles are indestructible, but we cordially invite the severest test and we feel sure that in the matter of strength and durability our goods will compare most favorably with those manufactured anywhere else. We also note your suggestion that naked flasks should not be sent to you, but here we would point out that any covering that we could put on them would have to be imported by us, and this would materially add to the cost, whereas should you decide to place an order with us we have no doubt that some firm in America would undertake the cover with material to be approved of by you. As it has occurred to us that the sample we sent you was rather small, we are now sending you a second bottle, to contain three pints."

The real way to find out the merits of a canteen is to carry it and depend upon it for the fluids that you drink.

The man who carries the canteen is usually indfferent as to its

material or construction and ignorant as to its theories, principles, or components. He is a judge of results, though, just as a marksman knows what the effectiveness of his rifle is, when he has become accustomed to the practical use of the firearm. The average man is more interested in what the canteen does than in what it is. He has no reliable means of proving what it is, but he needs no advice to tell him what it does. He makes no experiments or comparative tests; he has no opportunity to do so. He accepts the canteen issued to him as the best type and product of its class. He knows that water from the Regulation Canteen may be usable without being relishable or palatable. If given a chance to test the Regulation Canteen with the Lanz Canteen, it is believed the veteran would pronounce the latter a success. Until the arc-electric or incandescent electric lights came we never knew what flying animals were in the air, but we then found myriads of strange bugs immolated beneath the lights. Just as illuminating gas was superseded by the electric light, an improvement is demanded in the shape, construction and material of the Regulation Canteen.

There are two ways in which to fully and impartially consider the merits of any article of equipment intended for a soldier's use.

One preliminary way is to master in a workmanlike wise the practical details of its materials, construction, and principles involved.

The other way is to assume in postulatory kind of wise that certain results will follow a certain theory or conception.

But these reasoning processes or conclusions are sometimes proved untenable, or erroneous, by practical demonstrations. When these presumed conclusions are upset by the results of practical test, experiment or trial, the winner is entitled to the benefit. In these canteen tests something more than tentative methods have been practised. Every canteen has been placed on trial, and judgment and recommendations *succeeded, not preceded,* the trial. The conclusion is that the Lanz method is the best type for the military service. An opinion to the contrary expressed by any one who has not practically and thoroughly tested all of the devices, but entrenches himself behind an opinion as a fortress, is not entitled to weight.

Human labor cannot supply what nature has denied, but can simulate it. A good canteen is a necessity for which a soldier in the field would willingly exchange such luxuries in life as clothing, tobacco and solid food—particularly if he is a hunter who has

drank from cool springs of icy water hidden away in dark crevices in glades where shadows are never broken by the sun.

The ways in which the Regulation Canteen may be made the vehicle for the transportation of an impure water supply are shown, in part, in the quoted letter from Mr. Joseph A. Steinmetz.

Outbreaks of malarial fever have followed the use of impure water. The Regulation Canteen aids to spread infection, because, as a water carrier, it can carry the germs of fever, and because of the practical impossibility of sterilizing its contents by the soldier in the field.

The substitution of a canteen differing in material, construction and shape, would partly obviate these dangers.

The Patton Paint Company, Milwaukee, Wis., (see p. 104), writes again as follows: —"Canteens of wood, if they can be rendered absolutely impervious to water and so treated that they will give no taste to liquids which they hold, will be found more satisfactory than canteens made of metal or of any composition which would be practicable for service.

"We are conducting a series of experiments which lead us to believe that we have found a process of treating wood in such a way that a canteen turned out of a solid block can be coated on the inside with our special preservative paint and will resist the action of water, tea and coffee, giving no taste, and holding at an equable temperature any liquid which a soldier would be using in active service.

"These experiments, while they convince us of the possibility of fulfilling all the conditions to be met in actual use, will need some six months longer to enable us to guarantee the permanency of results which must be obtained if we are to back our statements with the reputation of the Patton Paint Company.

"The advantages of wood for holding water are obvious. Wood is among the best non-conductors of heat. It is stiff and hard, having considerable strength for resisting strains, blows and jars, with sufficient elasticity to resume its shape after undergoing almost any treatment but that of being crushed or broken.

"In tropical climates wood canteens will be found to keep the water and other potable liquids at a lower temperature for a longer time than tin, iron, or any other metal (whether enameled or otherwise).

"In resistance to cold, wood has equally high efficiency. It will withstand the freezing temperature better than any other substance of which canteens could be made.

"The only objection to the use of wood for making canteens is

that it is affected by the liquids that it contains. All liquids containing water permeate the pores of natural wood and under this influence the fibers rapidly undergo deterioration. The wood decomposes slightly if it has no chance to dry out and soon begins to taste of organic matter. After continued use, unless it is frequently washed and sterilized, the taste of the liquid contained becomes so unpalatable and the odor so unbearable that the wooden vessel must be discarded.

"In the special paint which we are making for covering the inside of wood canteens we claim that we have obviated all the difficulties which could be urged against the making of canteens from wood, and that we have retained all the advantages of the wood canteen and also those of an iron canteen which is enameled.

"The wood with changes of temperature will not expand and contract as iron does, to the extent of chipping and cracking the coating.

"In other respects the wood canteen, with inside coating of our enamel paint specially prepared for this purpose, will answer all the requirements of an enameled metal canteen and will at the same time preserve all the advantages of the old-time wooden vessel.

"This paint will be found to be absolutely impervious to water. Tea and coffee will not affect it, and liquids used in it will not taste as they would of an ordinary paint. A beverage containing a small amount of alcohol will do it no harm. The paint will stand any temperature from 150 degrees F. to far below the freezing point. The paint which we have recommended for this purpose we have carefully prepared to withstand any possible changes to which a canteen would be subject in the army service, from Arctic to tropical climates.

"Hot tea and coffee could be poured into this canteen and would not affect it adversely unless kept for a long time at a temperature exceeding 150 degrees.

"In fact, where a soldier can stand the exposure, either to heat or cold, this canteen can be used, we believe, with perfect satisfaction.

"We shall be glad, if this matter is taken up in future, to submit to you the results of our experiments in this line, and shall hope to see the wooden canteen adopted in the United States Army."

Mr. E. Dederick, of 2016 Cherry St., Milwaukee, Wis., writes:— "I read in the *Milwaukee Sentinel* that you are trying to arrange for a preparation for lining the inside of a wooden canteen. I have a preparation which when applied either to wood or iron forms a

coating like stone; this can be made any color except white; its natural color is slate. I have it in refrigerator boxes, where it has been used for the last seven years and is as good now as when first put on. It can be used for a great many things: covering for refrigerator pipes, to keep them from corroding; lining between double floors to keep them from leaking; also on vats that are liable to leak a coating of this does the business.

"If this should interest you, if you write me I will send you some samples on wood and iron and you can test them."

The Patton Paint Company, of Milwaukee, Wis., writes again as follows:—"The basis of my argument in favor of the paint which we recommend for wood canteens rests upon the fact that the paint is applied to wood rather than to any metal surface. If the same paint were applied to metal, it would act in much the same way as enameled metal-ware acts. It would chip, crack and scale with the expansion and shrinkage of the metallic surface upon which the enamel is baked.

"The great weakness of all enameled metal-ware is the fact that the enamel is applied to a substance which has a much larger co-efficiency of expansion than a substance which, like wood, is composed of fibers brought together and amalgamated under the law of growth and which has therefore intercellular spaces which take up the larger portion of motion that would ensue upon expansion of the fibers and therefore expand, when they do so, more slowly than the metal, which, from its lack of intercellular spaces, must at once yield to the force acting upon it in either enlarging or reducing the molecular orbit.

"The immediate result of the chipping and cracking of the enamel is that the liquid is admitted to immediate action upon the metal, which oxidizes and permits still further disintegration of the enamel, which in this way starts the process of undermining the enamel covering, so that chips are set free and small and large quantities are allowed to escape with the water, to be swallowed by the soldier.

"Serious trouble could arise in the way of poisoning if the enamel were composed, as is frequently the case, of white lead, which is more or less soluble, and which might easily affect the soldier, independent of the swallowing of small particles or chips loosened from the enamel covering.

"The excessive weight of enameled metal as compared with canteens made from wood, aluminum or tin, does not come so much from

the enamel itself, as from the weight of the metal upon which it is super-imposed."

I am indebted to the Western Felt Works, 787 to 797 South Canal St., Chicago, Ills., for the formula and the process methods of a test for determining the amount of wool in felt, or any wool, or part wool, fabric.

It should be known to every inspector of covered canteen flasks, or of woolen clothing or material furnished for the use of the combatant land or naval forces of the United States.

In courtesy to the company the test cannot here be given.

Sponge belongs to the vegetable kingdom. Mixed with an animal product—wool—the resultant compound—sponge-felt—may be open to some objections; perhaps resembling those found, practically, by the French navy when cellulose, composed of the ground fibre of the cocoanut, was tried, in compressed form—briquettes—to close the openings made and prevent the inflow of water, even if penetrated by projectiles—the protection of buoyancy method, so called.

As sponge grows in the water, and is used wet, it is at its best when wet; should be offered for sale wet. Sponges, when dry, are hard, rough and easily torn; when wet, sponges are much less easily torn. The difference between sponge and fish-glue and gelatine in dried and soaked state applies to sponges.

The strongest sponge is easily torn by pulling across the grain. The fair test is with the grain—everything has a grain. Wooden columns support buildings when placed with, or along, the grain, but wood across the grain can easily be broken.

"WE'VE DRUNK FROM THE SAME CANTEEN."

BY MILES O'REILLY.

There are bonds of all sorts in this world of ours:
Fetters of friendship, and ties of flowers,
And true lovers' knots, I ween.
The boy and the girl are bound by a kiss,
But there's never a bond, old friend, like this,
We have drunk from the same canteen.

CHORUS.

The same canteen, my soldier friend,
The same canteen:
There's never a bond, old friend, like this,
We have drunk from the same canteen.

It was sometimes water, and sometimes milk,
Sometimes apple-jack, fine as silk;
But whatever the tipple has been,
We shared it together in bane or bliss,
And I warm to you, friend, when I think of this,
We have drunk from the same canteen.

The rich and the great sit down to dine,
And quaff to each other in sparkling wine,
From glasses of crystal and green;
But I guess in their golden potations they miss
The warmth of regard to be found in this,
We have drunk from the same canteen.

We've shared our blankets and tent together,
And marched, and fought, in all kinds of weather,
And hungry, and full, we've been.
Had days of battle, and days of rest,
But this mem'ry I cling to, and love the best,
We have drunk from the same canteen.

For when wounded I lay on the outer slope,
With my blood flowing fast, and with little hope,
On which my faint spirit might lean,
Oh, then I remember, you crawl'd to my side,
And bleeding so fast, it seemed both must have died,
We drunk from the same canteen.

Upon the recommendation of the Inspector General, U. S. Army, the publication of the foregoing report was authorized by the Honorable, the Secretary of War, under date of 27th April, 1901.

Lieut.-Colonel & Inspector General, U. S. V.,
(Major 4th U. S. Infantry),
Inspector General, Dept. Dakota.

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